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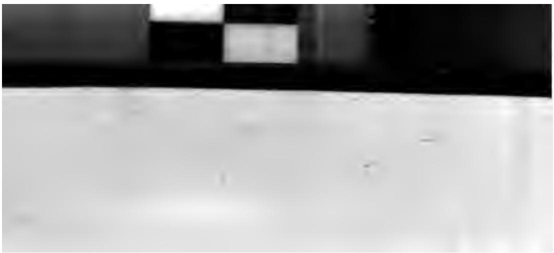

AN

ELEMENTARY INTRODUCTION

TO THE KNOWLEDGE OF

MINERALOGY:

COMPRISING

SOME ACCOUNT OF THE CHARACTERS AND ELEMENTS OF MINERALS;
EXPLANATIONS OF TERMS IN COMMON USE;

DESCRIPTIONS OF MINERALS,

WITH ACCOUNTS OF THE PLACES AND CIRCUMSTANCES IN WHICH THEY
ARE FOUND; AND ESPECIALLY

THE LOCALITIES OF BRITISH MINERALS.

BY WILLIAM PHILLIPS, F.L.S. M.G.S. L.& C.
Hon. Member of the Cambridge and Yorkshire Philosophical Societies.

THIRD EDITION, ENLARGED.

Nullum est sine nomine saxum. Lucan.

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The present differs from the preceding edition in some respects which appear to require notice in this place.

The most important additions and improvements that have been made, consist, first, in the introduction of notices or descriptions of about eighty minerals, of which the greater part have been discovered since the publication of the preceding edition; secondly, in the insertion of the results obtained by a careful examination of most crystalline minerals, as regards their structure and cleavage; thirdly, in the addition of a figure to the verbal description of most substances found in a crystallized state, representing the primary form, and another the secondary planes in connexion with those of the primary crystal, together with such measurements of the planes as I have been able to obtain, chiefly by means of the reflective goniometer of Dr. Wollaston; in the fourth place, advantage has been taken of a translation of Berzelius's excellent work on "The Use of the Blow-pipe in chemical analysis, and the examination of minerals by J. G. Children, F.R.S. L. & E. &c." in so far as relates to the more simple experiments with that useful assistant to the student in recognizing minerals; and fifthly, the meanings of the names by which minerals are commonly known in this country, are mostly given at foot of the page containing the description, except where, being chemical, they manifestly have been derived from the composition of the substance.

In regard to arrangement, no alteration has been made in this edition, except where new and more satisfactory analyses demanded a change: on the subject of the arrangement therefore, it seems requisite only to add that, having in the first instance adopted it as being in my own estimation the most advantageous to the student that I could devise, the experience of its utility now induces me to recommend it to him as an instructive method of placing the minerals in his cabinet.*

In pursuing the at once pleasant and laborious investigations connected with the important characters of cleavage, crystalline form, and measurement, and which were undertaken with the view of rendering the present edition more instructive to the student, it will be imagined that I have myself derived much information; and, although some new facts relative to these points have resulted, it must be acknowledged that much yet remains for future investigation.

If the more accomplished mineralogist should condescend to consult this little work, he will perceive that the measurements of the crystalline forms, and especially of the secondary planes, are not precisely exact, do not on all occasions relatively agree; for in no instance has it been attempted to correct the geometry of nature by a resort to the more rigid laws of calculation. It has been ascertained by a comparison of the measurements taken from similar and brilliant planes of different crystals, that, owing to some natural inequality of surface, the same precise angle is rarely obtained, and hence those given in the succeeding pages cannot be expected to be absolutely exact. Experience, however, leads to the conclusion that the limit of error is considerably within one degree,—that it rarely exceeds 40 minutes, and that it is frequently confined to a minute or two. The measurements annexed to the figures will therefore be considered only as near *approximations* to the true value; but where those of the primary form have been obtained from planes produced by cleavage, which is generally noted, when that is the case, in the description of the mineral, they may be considered as approximating the truth much more nearly than when taken by means of the natural planes. A considerable proportion of the whole will perhaps be found sufficiently precise to form a basis for the calculations of the mathematician, and, together with the accompanying figures, to induce the student to examine the forms of crystals, and to delineate, and measure the angles formed by the meeting of the planes by which the crystals in his own cabinet are bounded. If errors should be found in the following pages, greater than those above alluded to, they are to be attributed to my own want of exactness in noting the measurements obtained; for, although much care has on all occasions been taken to select the smallest and most brilliant crystals, and to note the results faithfully, it is scarcely to be hoped that errors of this nature have altogether been avoided.

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* Having adopted it in my own, I add that my plan is to place on the outside of each drawer a small card indicative of its contents;—thus supposing it to contain certain of the more compound alkalino-earthy minerals, the card has on the top it, say, ***SILEX***, ***alumine***, ***lime***, ***potash***, and beneath, the names of the minerals contained in the drawer.

It may perhaps be concluded, that by adopting at once the figures and measurements given by Haüy, and other mineralogists, much chance of inaccuracy might have been prevented. But it must be observed that where the primary form is not a regular geometrical solid, such as are the cube, regular octohedron, and six-sided prism, the means resorted to for determining the true measurements—namely, that of subjecting the planes obtained by cleavage to the reflective goniometer—is a more certain method than that adopted by Haüy; and it will be perceived that a very large proportion of all the primary forms are not regular geometrical solids, such for instance as the oblique and doubly oblique prisms, and the very numerous class of rhombic prisms. Where the cube, regular octohedron, six-sided prism, and other regular solids are the primary forms, I have adopted the measurements given by Haüy, acknowledging them in all cases by annexing the letter H, or by some other mode; first, however, verifying them in most cases by the reflective goniometer. In a very few instances, the authority of the Comte de Bournon has been resorted to, but not without acknowledgment. It will of course be understood that where no authority is mentioned the measurements have been obtained by the reflective goniometer, and from what is said above that they must be considered only as approximations.*

In regard to the figures to which the measurements are annexed, it may be observed, that these are not in all cases the representatives of single crystals, for in some of them are associated the planes observed on two or three: thus occasionally rendering the form more complicated than any single crystal I have seen, but not more so than may probably be found hereafter. This mode has been adopted as offering to the student the greatest assistance that I could devise, since it combines at one view all the observed planes, without increasing enormously the bulk and consequent expense of the work, as must have been the case if all the varieties of form had been given separately. As to the drawing of the figures, it remains to be added, that they are not given as the result of a laborious execution by the assistance of the rules of geometrical projection; but, in the general, only as diagrams wanting the precision which in that case might have been claimed for them, and drawn without any other rule than such as the hand and eye could furnish.

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* In some, though comparatively few instances, the crystals of a substance have not been found sufficiently bright for the use of the reflective goniometer; the common goniometer has then been resorted to, and the measurements taken by it are always distinguished by having the letters *c. g.* annexed to them.

The letters on each plane of the larger figures, have been so placed according to the *system of notation* adopted in the "Familiar Introduction to Crystallography, &c. by H. J. Brooke, F.R.S. &c." a work which may, without hesitation, be recommended strongly to the Student, as being calculated to teach the interesting science on which it treats in its most pleasing form, and of which the first part is so simple that, without any reference to trigonometry, geometry, or algebraical calculation, it shews, by means of the figures of crystals and attendant explanations, the position on the primary forms of every secondary or modifying plane to which those forms are liable, and thereby the transitions of one form into another; and here, if he be so inclined, the Student may stop, after having gained all that a purely mechanical view of the subject will afford him, or he may proceed to the Second Part, in which Crystallography is treated more scientifically; and it may be added that the pupil may, in either case, attain such a knowledge of it, as will not fail to open to him new sources of delight in this interesting department of Mineralogy.

To the author of the fore-mentioned work, I am under much obligation for assistance on various points connected with the improvements which it is confidently hoped will be manifest in the present Edition. Often as his name occurs in its pages, I have been yet more often indebted to him, not only for the loan of specimens, amongst which were several that I could not otherwise have obtained, but for assistance in the clearing up of many difficulties which, without his help, would have been left in doubt, or would have terminated in error.

My acknowledgments and thanks are also thus publicly due to several others of my friends. To Thomas Allan, F.R.S. L.&E. for many useful criticisms, of which I have not failed to avail myself, as well as for the liberal transmission from Edinburgh of some rare and valuable minerals. To Ashhurst Majendie, M.G.S. for the loan of well-defined crystals of several scarce substances. To Samuel Luck Kent, M.G.S. for a free access to his Cabinet upon all occasions, and for his cheerful permission to avail myself of the advantage in any manner that might tend to benefit the work, and even for the presentation to me of some rare substances. To Henry Heuland, For. Sec. G.S. for some valuable minerals presented to me in a manner consistent with his well known liberality; a liberality which also I have experienced in numerous instances from G. B. Sowerby, F.L.S. to whom likewise I am greatly indebted for many valuable hints, and for the readiness with which he has upon all occasions endeavoured to promote my views.

In conclusion, if the utility of a nice investigation of the *structure* of crystallized minerals, and the *measurement of their angles*, should become an inquiry, it may be replied that they often determine the differences existing between minerals which greatly resemble each other. This, as is observed more at large in the following 'Introduction,' is fully exemplified in the differences discovered by means of the reflective goniometer, between the measurements of the primary rhomboids of carbonate of lime, carbonate of lime and magnesia, and carbonate of iron; minerals which often so greatly resemble each other, that the difference between them can only be ascertained by a resort to chemistry, or the reflective goniometer. The utility of a close attention to this instrument has been further manifested since the foregoing was written, and in a very remarkable manner:—a mineral which has always been considered as bitterspar from the Tyrol, and of which the primary crystal is a rhomboid, not distinguishable by the unassisted eye from that of either of the foregoing, was found by the reflective goniometer to afford measurements differing from them all; the cause of this became manifest by a resort to analysis, which proved it to be a new compound, namely, a carbonate of magnesia and iron. The reflective goniometer is moreover of great use to the Geologist, who finds those rocks which are termed primitive, and many of those which are called transition, or the oldest secondary, to consist, not of one homogeneous mass, as is often the case with those of a newer origin, but of two or more minerals so intermixed and associated, that a reference to the Chemist is of little avail to him; by such means he may indeed become informed, whether a particular earth or alkali is to be found in the mass, but the various substances of which it is compounded are often too minute, and therefore too intimately associated with the others, to allow of a determination as to which of the component substances may contain the earth or the alkali so discovered. Hence structure, if it exist, becomes a character of essential importance; for it will be found that fragments, far too minute for analysis, will often afford brilliant planes well adapted to the use of the reflective goniometer. A knowledge of Structure therefore, and of the measurements of the primary forms of minerals, is very important to the Geologist; but where structure does not exist, the examination of the various external characters of the minute portions forming the aggregate of the rock, are often of singular advantage; and hence the Geologist should become intimately acquainted with the external characters of at least all such substances as are found entering into the composition of rocks. Mineralogy therefore is in reality essential to the Geologist; it is the very *alphabet to the older Rocks*, and it is probably to be attributed in great measure to the want of due preparation for the study of these rocks, by an intimate acquaintance with minerals in the *simple* state, that the primary and transition tracts of England and Wales, have been investigated in a far less degree than those of a newer origin.

'It has been said of Crystals,' says the Abbé Haüy, 'that they are the flowers of minerals; an observation concealing a very just idea beneath the air of a comparison which appears to be only ingenious.' The importance of '*form* will become more evident' he further observes, 'if in pursuing our inquiries into the niceties of the mechanism of structure, we conceive all these crystals as the assemblages of integrant molecules perfectly resembling each other, and subject to the laws of regular arrangement. Thus, although by a superficial notice of crystals we might adjudge them to be only the sports of nature, a more intimate acquaintance with them leads to this conclusion,—that the Deity, whose power and wisdom prescribed the unerring laws of the planetary motions, has also established those which are obeyed with the same fidelity, by the molecules composing the various substances concealed in the recesses of the Earth.'

May 10*th*, 1823. W.P.

PREFACE

TO THE SECOND EDITION.

THIS second, and, as I trust it will be found, greatly improved edition, bears an aspect, in some if not many respects, different to that of the first edition.

In this, the physical characters of minerals are treated of in such a manner as appears to be consistent with the object of the work: the explanations of terms have been revised, and are considerably increased: and as most of the known substances are now described, this will be found far more copious than the former edition. The synonyms are given to such an extent as seems useful, and have been derived from the works of three eminent French mineralogists, Haüy, Brochant, and Brongniart; those of Werner have been taken from the work of professor Jameson; from which also, and from the 'Manual' of Aikin, the names adopted by their authors are given, when they differ from those under which the minerals are described in the following pages.[*] The synonyms will however be found much more at large in the useful 'Nomenclature' of Allan. The figures[‡] of the primary, and some of the most important secondary crystals, which in this edition are annexed to the accounts of most of those minerals which have been found in regular forms, will it is hoped be useful; inasmuch as these figures, and the familiar descriptions accompanying them, will form, as it were, a stepping-stone for the beginner to the curious and interesting department of crystallographical research. Figures and descriptions of both goniometers have likewise been added, together with remarks on their use and comparative value. Much attention has been given to collecting the localities of the minerals of our own country; and in this, the catalogue of my own cabinet, which includes a large proportion of the known British minerals, has been of great advantage.

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[*] Only the first letters of the names of these authors are added to their synonyms, except that Brochant and Brongniart are distinguished from each other; the former by the Br. the latter by the Bt. When any other author is quoted, the name is given at full length.

[‡] These figures were engraved on wood by W. Hughes, of No. 17, Hatfield Street, Blackfriars Road, who possesses great skill in the various departments of his art. That errors will be observed in some of the figures, is beyond doubt; but as they belong to the drawing more than to the engraving, they are less the fault of the engraver than of the author; for whom, it may be allowed as an apology, that all those which are annexed to the descriptions of minerals, were drawn without even the aid of a ruler; for the great length of time required for their delineation accurately by geometrical projection, forbade the attempt, but it is hoped that they will be intelligible.

On the subject of the order of description adopted in this edition, a short chapter will be found in the Introduction, preceding the 'Tabular Arrangement.*' It seems requisite only to say in this place, that in principle it differs but little from that of the first edition. As the smallness of the type and the thinness of the paper of this volume, will probably be objected to by some, I wish to observe that they were preferred with the intention of compressing the whole as much as possible, in order to adapt the book to the convenience of the young mineralogist, and of the traveller.

The most effectual and advantageous method of acquiring a competent knowledge of minerals, is undoubtedly that of personal instruction. The superiority which France and Germany have attained in mineralogical science, is in great measure to be attributed to the facility of obtaining instruction, both public and private; of which there was an almost total deficiency in this country, until lately. Each of our Universities has now its professor, and private instruction is attainable. The metropolis and its neighbourhood are not without advantages in this respect. Lectures are given at the public Institutions. The time and attention of Mrs. Lowry, of Titchfield Street, whose fine collection of minerals, and of models and instruments used in mineralogical and geological researches, cannot fail, under her instruction, of being advantageous to her pupils, are occasionally given to this object: and T. Webster, of No. 20, Bedford-street, Covent-garden, who is one of the Secretaries of, and Draughtsman to, the Geological Society, and has the immediate care of its valuable collection, and whose acquirements may thence be estimated, also dedicates a part of his time to instruction in the sciences of mineralogy and geology, as well as to the teaching of drawing; a knowledge of which is intimately connected with those sciences, and in the instruction of which he has adopted the most expeditious and advantageous methods he can devise.

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* The Tabular Arrangement includes the varieties of each mineral. Thus, Tremolite is noted as occurring crystallized, fibrous, and asbestiform; which allows the opportunity of placing on the page a mark against each variety included in the cabinet of the collector, and the number of the drawer in which it is deposited; thus affording at once a catalogue of the cabinet, and the means of a ready access to each specimen.

Instruction in crystallography is also attainable. N. J. Larkin, of Gee Street, Somer's Town, who is a teacher of the mathematics, is in the habit of teaching their application to the theory of crystallization. A perfect knowledge of this most beautiful theory can only be attained by a correct acquirement of the mathematical principles on which it is founded; nevertheless, the theory is also taught mechanically by N. J. Larkin, in a few Lessons, by the assistance of models. These models, cut in box-wood, with great accuracy and beauty, may be had of Bate in the Poultry, and Mawe in the Strand, at one guinea each, as well as complete sets of models of all the crystals described by Haüy in his Treatise on Mineralogy, at the price of sixteen pounds the set.

Mineralogy, as it is too commonly pursued, is made to consist more in the recognition of minerals than in the knowledge of what may be termed its principles;—more in the possession of specimens, and in that satisfaction which arises from arranging them in their places, than in subjecting them to those investigations which, when once they are attempted, are found to constitute the real value and even the charm of the science. The beginner may be assured that it is replete not less with entertainment than with instruction; for whether the observation of the physical characters—of structure, phosphorescence, or electricity—or whether the blow-pipe, or those investigations which belong to chemistry, may be most congenial to him, each will be found to possess an ample source of gratification, in the instruction which curious phenomena never fail to convey to the mind, and in the exertion of the ingenuity required for their developement.

It may be assumed that the physical characters of minerals are more likely to interest the generality of students, as being more obvious, and probably more consonant with their general pursuits, than the chemical characters. Of the physical, Structure will be found the most inviting and most uniform, and therefore the most important of them all. The manner in which it is treated of in the Introduction, being purely mechanical, is not likely to satisfy the mineralogist, for whom indeed it is not designed; but perhaps may interest the student sufficiently to induce him to pursue the subject still further; and what if I say, to tempt him to complete his acquirements by a resort to the works of the Abbé Haüy, in which he will find Structure, and its interesting and beautiful consequence, regular external form, illustrated by the application of the mathematics to its laws.*

The discovery of a new earth, a new alkali, and three new metals, has of late increased the catalogue of mineral elements. This catalogue (Introduction, p. xlviii) offers to our notice some striking considerations, when viewed as including, according to the present state of our knowledge, all the component materials of the crust of the globe. This crust however is primarily constituted of earthy compounds, in which only two or three of the metals are found either intermixed, or in a state of combination; for the metals and metalliferous ores principally occur in the veins which traverse mountainous or hilly countries, and their quantity, as compared with that of the rocks which enclose them, sinks into insignificance. The alkalies occur in too trifling a proportion to be of much consideration in this point of view; and the acids, excepting the carbonic, and their bases, excepting perhaps only carbon, are similarly circumstanced. But if we would look still more narrowly into the composition of the crust of the globe as consisting chiefly of the earths and earthy minerals, we shall find that only three of the ten earths which have been discovered, namely, silex, alumine, and lime, are found to constitute its great bulk; for although magnesia is a constituent of a mountain rock, it is by no means plentiful, nor does magnesia enter into its composition in a large proportion. The other earths are found only in comparatively small quantity, and chiefly if not altogether in veins.

If however we pursue the investigation further, we shall find that the three earths above mentioned are compound bodies, consisting on the average of about 50 per cent. of oxygen, combined with the bases, silicium, alumium, and calcium, in the proportion also of 50 per cent. in the aggregate.

Now if we turn our attention to what is known of the nature of these four elements, oxygen, silicium, alumium, and calcium, which primarily constitute the great mass of the crust of the globe, some curious facts will be presented to our consideration. The first and most abundant element, oxygen, has eluded the vigilant eye of the analyst, being known to him, in its purest state, only in combination with caloric, as a gas:—silicium and calcium, although they may have been rendered visible, can

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[*] In the investigation of the structure of minerals, their partial destruction at least is inevitable: but for this or any other investigation connected with the science, specimens smaller and less valuable than the generality of those admitted into our cabinets will suffice. But whenever I have had occasion to seek specimens for such purposes, I have always found in the mineral dealers of the Metropolis, a prompt and liberal attention to my wants.

scarcely be said to have been seen in a separate form, and hence their precise nature is unknown;—while calcium has been observed to possess the colour and lustre of silver; but as it spontaneously takes fire the instant of its exposure to the air, its nature has not been examined.

It is admirably observed by my friend J. G. Children, that "with four simple elements (oxygen, hydrogen, carbon, and nitrogen, a brief alphabet for so comprehensive a history) has a bountiful Providence composed the beautiful volume of the *living world;* where turn to what page we may, fresh loveliness meets the eye, fresh cause of admiration and delight." (Essay on Chem. Analysis, p. 271.)

That part of the creation therefore, which is *animate*, is composed of some of the same elements as the *inanimate:* and, according to the present state of our knowledge, the elements employed by the great Artificer of the Universe, in the formation of the globe, and all the animal and vegetable creation, scarcely exceeds the number of fifty (Introd. p. xlviii) reckoning as elements some substances which are suspected to be compounds. And when we reflect upon the fact, that a very few of these actually constitute a very large proportion of the whole;—upon the nature of these elements, that several even of those which have been employed in by far the most important degree, have either eluded our research, or are known to us chiefly by their agencies;—upon their wonderful arrangement, subservient to the purposes of organization in the living, and structure in the inanimate;—upon the affections and properties of matter in general; we may adopt the language of the Abbe Haüy, and say, that Nature is thus exhibited "under an aspect which claims for its Author, the tribute of our admiration and our reverence."

May, 1819. W. P.

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INTRODUCTION.

§ 1. THE investigation of the structure of the earth belongs to the science of Geology. It may however be interesting to take a rapid survey of the present state of our knowledge respecting it, were it only for the sake of shewing its intimate connexion with mineralogical pursuits.

In speaking of the earth and of our knowledge of its nature, it is essential that the limited extent of that knowledge should always be had in remembrance. We are acquainted with it, only to a very inconsiderable depth; and when it is recollected that, in proportion to the bulk of the earth, its highest mountains are to be considered merely as unimportant inequalities of its surface, and that our acquaintance does not extend in depth, more than one-fourth of the elevation of these mountains above its general level, we shall surely estimate our knowledge of the earth to be extremely superficial; that it extends only to its crust.

The term 'Crust of the Earth' therefore relates only to the comparative extent of our knowledge beneath its surface. It is not used with the intention of conveying an opinion that the earth consists only of a crust, or that its center is hollow; for of this we know nothing. The term may not be philosophical, but it is convenient.

The nature of the crust of the earth is most readily studied in mountains, because their masses are obvious; and also because, as they are the chief depositories of metalliferous ores, the operations of the miner tend greatly to facilitate their study. Mountains are composed of masses which have no particular or discernible shape: or, as is more commonly the case, of strata or beds, either horizontal or oblique, sometimes nearly vertical.

In these masses and beds different structures have been observed. Some of them are crystalline; that is to say, are composed of crystals deposited in a confused manner, as in granite, or of crystals imbedded in some other substance, as in porphyry. These crystalline rocks contain no organic remains; and, as they are always found beneath, never above, those which do contain them, they are considered to have been of earlier formation, and therefore have been termed *Primitive rocks.*

Other mountain rocks have no appearance of crystallization; but, on the contrary, seem rather to have been formed by the mere falling down, or settlement, of the substances of which they are composed, from the solution which contained them. These are always found above, never beneath, the crystalline rocks; and often contain a vast abundance of organic remains, both animal and vegetable. The more ancient of these, or such as contain the remains of animals of which the genera and species are extinct, are called *Transition rocks:* the more recent, or such as contain the remains of animals most nearly resembling those now inhabiting our oceans, are called *Flœtz* or *Flat rocks*, because their position is considerably, or perfectly horizontal: the former have received the name of Transition, as connecting the primitive with the flœtz rocks. By many mineralogists the transition and the flœtz are classed together under the name of *Secondary rocks.*

Primitive and secondary rocks have suffered considerable change and ruin from causes which it is not our present object to notice; and their disintegrated portions, having been formed anew, now constitute that peculiar description of deposit which is termed *alluvial*, or *diluvial*, and which therefore consists of *debris* of rocks. Such are some clays, gravel, sand, &c. and these often contain the remains of land and amphibious animals, and of fish: they are found above the preceding, or sometimes resting immediately upon primitive rocks.

But there is still another and a very different kind of rock, abundantly found in certain countries, which may in great measure be considered, like the preceding, as resulting from the ruin of rocks, but from an opposite cause, or by an agent directly the reverse, viz. by fire; constituting those known by the name of *volcanic rocks:* many of these strongly bear the marks of heat, and even of fusion; some, on the contrary, offer no evidence of their having been subjected to heat.

Lofty mountains composed of primitive rocks usually present rugged and uneven summits, and steep acclivities on the sides, as though they had suffered by convulsion. Such as are wholly or externally composed of secondary beds or strata, are less rugged on the summits and sides; their summits are flattish, or somewhat rounded, and their sides present acclivities more easily accessible; and are still more so when covered by alluvial matter, which serves to fill up their roughness and hollows, and often presents a nearly plane surface.

Both primitive and secondary mountains, more particularly the former, are traversed in various directions by fissures, of different dimensions. Those fissures are not often empty, but are partially, and sometimes, though but rarely, wholly filled with stony or metalliferous substances, but not often by portions of the rocks they traverse. These fissures are termed *Mineral Veins:* of whatever substance or substances the body of a vein may be composed, its sides are commonly very determinate, and are by the miner called the *walls* of the vein.

From these veins, a large proportion of all the minerals which are found in the cabinet of the mineralogist, are extracted; indeed almost all such as, from their rarity, brilliancy, or peculiarity of form and combination, possess the greatest attraction for the mere collector; but these, though in these respects they may be the most curious, are by no means the most important.

Mineralogy is a science of so great interest, that it would be much to be regretted if its real objects and tendency were misunderstood, or suffered to degenerate into an avidity merely for the collecting of what is brilliant or rare. It is capable of affording larger and more useful attainment than the possession of an unique. To the attainment of the science of geology, which is intimately connected with agriculture and the arts of life, that of mineralogy is essentially requisite.

The study of mineralogy therefore does not include only a knowledge of the more rare and curious minerals; there is nothing in the mineral kingdom too elevated or too low for the attention of the mineralogist, from the substances composing the summits of the loftiest mountains, to the sand or gravel on which he treads. It is true that the aggregated masses of compound rocks are not arranged in a mineralogical collection; but it must be remembered that each of the substances of which such aggregated masses are constituted, are all comprehended in a mineralogical arrangement, and therefore find their places in the cabinet. Granite, it is true, is not to be found there; but its components, quartz, felspar, and mica, are met with in every one.

Thus, then, by the study of what, in opposition to the term *aggregated rocks*, may be termed *simple minerals*, the mineralogist becomes enabled to detect the substance with which he holds acquaintance by itself, when aggregated with others in a mass; and thus he becomes qualified for the more difficult, and more important study of the science of geology; which embraces a knowledge of the nature and respective positions of the masses and beds composing mountains; and indeed of country of every description, whether mountainous or otherwise.

It is not, therefore, or at least it ought not to be, the sole object of the mineralogist, to be able to distinguish the several genera and species of mineral substances; nor should his attention be confined to the mere task of recognizing a mineral at first sight, or of being capable of at once assigning it a proper place in his cabinet. He should hold a more enlarged acquaintance with minerals, and with the circumstances attending them, in what may be termed their *native* places; he should know something of the positions they respectively bear towards each other in those places; he should become acquainted with their *relative ages*, deduced from the nature of the rocks in which they are found; their comparative scarcity or abundance; their combinations; the *countries* in which they occur; and their *characters*, both internal and external.

This knowledge, it may be repeated, is the first and requisite step in the science of geology: not that it is essential to this science that every mineral should be accurately known: some are of comparatively little importance in a geological point of view, from their extreme scarcity; but it is essential to become acquainted with simple minerals in the general, because of some of them, many of the vast masses of the earth are composed.

Minerals which are found only in primitive rocks, are said to belong to *primitive countries*; by which name are designated such tracts as are chiefly composed of primitive rocks. The substance in or on which a mineral is found, is called its *gangue* or *matrix*; when in its natural place or position, a mineral is said to be *in situ*; when this place and position are known, we are acquainted with its *habitat*.

OF THE CHARACTERS OF MINERALS.

§ 2. It is one of the first, if not the first inquiry of those who are uninstructed in mineralogy, if a specimen, of quartz, for instance, to be shewn to them, how they may recognize it. The reply necessarily is, that it is essential to observe it closely, to study it, to mark with precision its characters:—that as minerals are not organized bodies, their characters are less defined, and therefore not so readily intelligible, as those of such bodies as possess regular organization:—that, in fact, there is no treatise, by a reference to which, the beginner is enabled, if he take up a mineral, to arrive at once at a knowledge of its nature:—that therefore at present practical observation is the only mean of attaining this knowledge. It will be of advantage, then, that these characters, and the mode of observing them, should be pointed out.

§ 3. Although long experience and attention give a facility in recognizing minerals by mere inspection, this facility can only be acquired by such means. There are some few minerals which may at once be detected by some simple experiment; that is to say, there exist a few possessing some one character which decides with precision what the mineral must necessarily be, because that character belongs to no other mineral. For instance, there are three substances which often so nearly resemble each other, that simple inspection perceives no difference, even when reduced by cleavage to the primary form. All may be cleaved into obtuse rhomboids, differing from each other in measurement. If the planes of one of them meet at the angles of 105° 5′ & 74° 55′, it is carbonate of lime; if the second measures 106° 15′ & 73°.45, it is bitterspar; the third, measuring 107° & 73° is carbonate of iron. But comparatively few substances can be known by so simple a process: some cannot be cleaved with regularity; we must then resort to other characters, and it is often only by a comparison of a number of these that we can accomplish the desired object. It is therefore essential that the characters belonging to each should be faithfully detailed in describing it, since there is no book to which the beginner can resort, that will enable him to distinguish the generality of minerals with facility. He whose knowledge should enable him to accomplish such a work, would, by uniting in one focus all the labours of his predecessors, do the greatest service to the science which it has yet experienced.

§ 4. The characters belonging to most simple minerals may be said to be numerous; if its parts cohere, it possesses some degree of *hardness;* by trying its hardness, we may discover the ease with which it breaks, or its *frangibility*; and we may or may not perceive that it possesses a regular *structure*; if the structure be regular, we may discover the forms into which it may be divided, and amongst them, that from which all the rest may be derived, or, its *primary crystal*; and these regular forms may be termed the *geometrical characters* of the substance. These however, and numerous other characters, are commonly included under the term of *Physical or external characters.*

§ 5. These characters are extremely important; but with whatever precision they might be given, we should still be very far from a competent knowledge of the real characters of the substance, without the aid of the chemist. It is true that the study of the physical characters of a mineral, and a comparison of them with those of other known substances, has, in some instances, enabled the late celebrated Abbé Haüy (to whom we are indebted for almost all that is philosophical in the science, which he mainly contributed to rescue from empiricism) almost to decide, by analogy, upon its constituent elements; yet, it is nevertheless obvious, that no investigation could be complete without *chemical analysis*; which indeed may be said to be the very *basis of the science.*

§ 6. Hence the characters of minerals may be said to be of two kinds: *Physical* or *external*, and *Chemical.*

1. OF THE PHYSICAL CHARACTERS.

§ 7. These characters are numerous, and require for their proper comprehension, that they should be well defined, in order that the same language may always convey the same definite idea; there exist however, and often in the same substance, such very nice shades of difference in certain of these characters, that much at last is necessarily left to experience. The learner will find that after a laborious endeavour to discover by written description what a mineral is, it will be much more easy to discover what it is not: in the present state of the science, he will reap an infinitely greater and more speedy advantage from personal instruction than from books. Such, however, as can resort only to the latter, will find that an attentive observation of the physical characters, and a comparison of them in different minerals, will forward the acquisition of knowledge.

These characters may be said to be comprehended in the following list.

External form
Structure
Fracture
Frangibility
Hardness
Transparency
Lustre
Colour
Flexibility
Elasticity
Double refraction
Touch
Taste
Odour
Streak
Powder
Adhesion to the tongue
Magnetism
Electricity
Phosphorescence
Specific gravity

Some of these characters belong to every mineral substance; others only to a few. It is however essential that all should receive attention; and therefore they will be treated of separately in immediate succession: and, as the learner will, in all probability, find occasion for frequent recourse to these explanations, it has occurred to me that it will be advantageous for the sake of easy reference, also to place many of them alphabetically amongst the explanations of the terms belonging to the science; explanations which, however dry and uninviting they may seem at a first glance, will be found of considerable utility.

*External Form.**

§ 8. Not any considerable proportion of the specimens admitted into our collections of minerals can be said to possess any precise external form, since they mostly exhibit on one side or the other, and are sometimes entirely bounded by, surfaces produced by fracture; there are comparatively few minerals which are found in masses absolutely isolated.

§ 9. Nevertheless there are many minerals to which particular external forms belong: some few are found in single or separate *crystals*, and the surfaces of others are coated by them.

A *crystal* may be defined as a more or less symmetrical, geometrical solid, commonly bounded by plane surfaces, which in mineralogical language are termed *planes* or *faces*.

An *edge* is formed by the meeting of two planes.

A *solid angle* is a point formed by the meeting of three or more planes.

A *prism* is rarely found having only three sides, very commonly four, six, eight, or more sides; the sides, or *lateral planes*, surround its *axis*, which is an imaginary line passing down the middle of the prism, from the centre of the upper *terminal plane* to the centre of the lower: the terminal planes are also called the *bases*. But prisms are found both very long and very short; when very long, and the crystals are very slender and curved, they are termed *capillary*, when straight, *acicular*; when the prism is very short, the crystal is said to be *tabular*.

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* It is not without some hesitation that I venture to retain in this edition, the very slight outline given in the former, on the two important subjects of 'External form' and 'Structure.' They may however serve to convey to the student some, though a very inadequate idea of their importance: but I wish strongly to recommend not simply for his perusal, but to his best attention, the Treatise on Crystallography, by H. J. Brooke, F.R.S. &c. already mentioned in the advertisement to this edition, in which these subjects are treated at large.

A *pyramid* is formed by the meeting of three or more planes at a point, which is termed the *apex*, each plane being bounded by *edges*; considered separately, a pyramid is supposed to have a *base*, which is the case in regard to the tetrahedron; but in respect of most other forms, it is only imaginary, as in the instance of the octohedron, which often is termed a double four-sided pyramid; and also the dodecahedron with triangular faces, which often is termed a double six-sided pyramid.

The *prism* and the *pyramid* are however often combined in the same crystal; which in that case is generally described as a prism of four, six, or eight sides, *terminated* by a pyramid of four or more sides.

§ 10. We have spoken of the *edges* and *solid angles* of crystals; these however are sometimes wanting; for instead of the edge or the solid angle, we find a plane; the edge or solid angle is then said to be *replaced*, or *truncated*. These terms are neither true nor philosophical, but have arisen from the imperfection of language, which allows not of our expressing this fact correctly; neither the edges nor angles ever were on the crystal, and therefore could not have been replaced, truncated, or taken off. They are merely the terms of convenience. When however it is said that the lateral or terminal edges are replaced, or when a solid angle or an apex is said to be replaced; it is meant only by a *single plane*, unless expressed to the contrary.[*]

When the edges of a crystal are replaced by two planes, separated only by an edge, they are said to be *bevelled*.

§ 11. These truncations and bevelments are sometimes so slight as not to alter the *general* form of the crystal; but are often so deep as to give a perfectly different figure to it. Thus the octohedron *passes into* the cube, the cube into the octohedron, and the latter into the rhombic dodecahedron, as will presently be shewn.

§ 12. These passages of one form into another, and in many more respects than are above recited, are constantly found to occur in certain mineral substances. This is not ideal. For not only may a series of crystals be observed which exhibit these transitions, but they may also be proved by evidence of the most convincing kind, arising out of an examination of these crystals by a method more decisive than that which depends on the accuracy of the eye. I allude to the fact that the crystals of many substances may, *by the application of force*, *be mechanically divided*, or *cleaved*, in the *direction of the laminæ* (along their *natural joints*), so as to reduce the one form into the other; but the consideration of this fact belongs properly to that division of the subject which may be denominated Structure.

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[*] We must however make certain exceptions to some of the preceding remarks in regard to prismatic crystals. Every crystal which has lateral and terminal planes, is not considered as being prismatic; as for instance the *Cube*, which is a solid of perfect proportion, all its sides being equal; so with the *rhombic dodecahedron*, which also appears in some points of view, as having lateral faces: but as these solids are perfectly symmetrical, their apparently lateral and terminal faces are never so distinguished, and, when their edges are replaced, the fact is merely stated without distinction; indeed it commonly happens in these perfectly geometrical solids, and in others, as the regular octohedron, and the tetrahedron, that *when one edge is replaced, the others are likewise replaced.*

Of Structure.

§ 13. Structure, when it exists in a mineral substance, arises from the particular arrangement of the minute portions or molecules, of which it is composed.

§ 14. In some minerals, this arrangement exists both in the regular crystals in which these occur, and in those masses which have no particular external form.

§ 15. Of the forms of those minute and imperceptible molecules which are aggregated by the law of attraction into masses, nothing is known with certainty. Conjecture has in some instances been allowed to supply the deficiency. The consequences of their arrangement however are very perceptible, and may be satisfactorily proved in some instances, by the rudest attempt; a slight blow, or letting fall a specimen of certain minerals on the floor or the pavement, will suffice to produce instantaneous conviction that this arrangement does exist: for by such means fragments of perfectly regular form may be obtained, and from the faces of these fragments may again be procured thin slices, of which the larger planes are perfectly parallel, and these slices may again be subdivided into regular forms, until the fragments shall no longer be perceptible without the help of the lens.

§ 16. Structure, then, it may be repeated, arises from the particular arrangement of the minute portions or molecules of which the mineral is composed.

§ 17. If a mineral can be *mechanically divided* or *cleaved* in directions which produce only one particular form, that form is commonly termed its *primary* or *primitive crystal*. For instance, calcareous spar can only be cleaved into the form of an obtuse rhomboid of particular measurements, which therefore is termed its primary crystal; a rhomboid has six planes, which are parallel two and two. Calcareous spar therefore has three cleavages; it possesses *natural joints in three directions*: so has common salt, of which the primary form is the cube.

But some minerals are not so circumstanced. Fluor spar, which may be cited as yielding with ease to mechanical division, is an instance. It yields to cleavage in four directions, and affords three different forms, a regular octohedron, a regular tetrahedron, and an acute rhomboid; of these the first has arbitrarily been selected as the primary crystal, and convenience may be assigned as the reason for the preference.

§ 18. Other substances may be cleaved in a still greater number of directions; for instance, blende, from which may be extracted a rhombic dodecahedron, and from this an obtuse rhomboid, an octohedron, an acute rhomboid, and an irregular tetrahedron; in this mineral also, the choice of a primary crystal has been arbitrary; the rhombic dodecahedron has been selected.

§ 19. Other instances might be cited, but these will suffice; they are particularly quoted because of the remarkable ease with which the learner may satisfy himself of the facts.

§ 20. There are some minerals which yield to mechanical division with ease only in one direction, of which the topaz is an instance: many others might be adduced. The structure of such minerals is described as being *perfectly crystalline or lamellar in one direction.* The sapphire yields to cleavage in one direction with much ease; in the others with extreme difficulty.

§ 21. The arbitrary selections just noticed will sufiice to induce the suspicion, that in this department Mineralogy has not yet attained perfection; and also to induce the pupil to investigate, as he advances in the science, rather than to take for granted what is asserted without proving the facts.

§ 22. Other circumstances also exist sufficient to make us extremely cautious on this point.

Some minerals, to which primary forms have been assigned, do not yield, or have not yet been found to yield, to regular mechanical division in more than one direction, or even not in any direction. In these determinations one of two modes has been resorted to. In the first, thin fragments of the substance have been held up between the eye and the light; and by this means the extraordinary sagacity of the Abbé Haüy, has enabled him in several instances to deduce the probable form of the primary, from the directions of the crevices, or *appearances of natural joints* which may be observed in the fragment; and, in many, these have afterwards proved to be correct. By the other mode, the primary form is determined by *analogy*, that is, by a comparison of the forms of the crystals of a mineral with those of other known substances; but this may in some cases prove a source of error.

§ 23. Mechanical division may be accomplished by various methods, dependent on the nature of the substance. In some, as in blende for instance, it is best effected by a sharp knife, when the substance is held between the fingers, because of its numerous natural joints, which a blow might disturb in the wrong direction. In sulphate of strontian, it is best effected by the same means for another reason; namely, because it is easily cracked in directions contrary to the natural joints even by a slight blow. Fluor is best cleaved by putting it on a table and placing the edge of a knife along the natural joints; a slight blow then separates them. The oxide of tin yields only to the pressure of the cutting pincers, when held in proper directions. But on this subject I wish to refer the reader to my communication to the Geological Society, 'on the primitive crystals of certain substances, and on the modes of cleaving them,' which is inserted in the 4th volume of its Transactions. I am induced to refer to it as containing the only practical hints that have been published on the subject.

§ 24. By one or other of the preceding methods, however, most minerals have had assigned to them some one solid, as the *primary form* of the several varieties of crystals in which they are found.

§ 25. The whole number of primary crystals, are comprehended in the following varieties.

The regular tetrahedron, the cube, the rhombic dodecahedron, the octohedron, the six-sided prism, and the parallelopiped.

The first three may be termed regular geometrical solids, all the planes of each, being equal and similar; so also that variety of octohedron, which is termed regular, because all its planes are equal and similar, and all their sides are of the same length. There are however octohedrons which are termed acute or obtuse, because the two pyramids of which each is composed, are higher or lower than those of the regular octohedron; in these the sides of the planes are not equal and similar. Six-sided prisms, as primary crystals, are of various lengths. The term parallelopiped includes all those solids whose bounding planes are parallel two and two; as for instance, all the varieties of the rhomboid, both acute and obtuse; and all the prisms both right and oblique[*] of which the terminal planes are rhombic, and all the square and rectangular[†] prisms which do not possess the precise proportions of the cube. (See 'Explanation of Terms,' octohedron, prism, rhomboid, &c.)

§ 26. Whoever undertakes, for the first time, the examination of the crystalline forms of a mineral, will find, if they be numerous, that many of them seem to possess *no mutual relation.*

§ 27. He will however eventually discover that a substance, from whatever country it may be brought, always assumes crystals, which, if they yield readily to mechanical division, will always afford by it the same *nucleus* or primary form.

§ 28. Hence we have a right to conclude that the form of the molecules constituting these crystals must invariably resemble each other in the same substance, and that their arrangement must be invariable in regard to each other.

§ 29. How comes it then, will be the inquiry, that so great a diversity of external forms should be produced by an invariable internal arrangement? A satisfactory answer to this question cannot perhaps be given. We only know the fact; and are compelled in general terms to suppose it to be the consequence of affinity, or attraction, or polarity; of laws to which matter is subject. We must not, however, fail to notice the curious and important fact that the crystals of a mineral, from what part of the world soever it may be brought, and however unlike each other at first sight in external form, will always be found to possess such a mutual relation as will enable the observer to trace them to the same primary form.

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[*] Being aware that the most accurate verbal description of crystalline forms, conveys to the mind in most instances only a very imperfect idea of them, it would have seemed requisite here to give those which are above mentioned as the primitive or primary forms, if the figures annexed to the following descriptions of minerals, were not calculated to speak intelligibly to the eye. Amongst them, however, there is one which demands an observation. The term *oblique prism* is usually and correctly used to designate one in which, supposing the lateral planes to be held perpendicularly, the terminal planes are not at right angles to them, but are placed *obliquely*—at a greater or less angle than 90 degrees. (See Prism, 'Explanation of Terms, &c.')

[†] A *square* prism is necessarily rectangular; but there are prisms of which the planes are at right angles one with another that are not *square*, a term which implies that all the planes are of equal width; when not of equal width, these prisms are simply termed *rectangular*.

§ 30. A few of the many minerals which may be cleaved with regularity have already been noticed (§ 17), and we have pointed out the manner in which the crystals of certain substances may be reduced to their primary forms (§ 23.)

§ 31. Let us now give some attention to the manner in which the primary forms of certain minerals may be supposed to have increased, so as to assume external forms which appear to have little or *no affinity with the primary forms.*

§ 32. If we take a crystal of fluor in the form of the *cube*, we shall find that *all its solid angles* may readily be taken off by means of a knife; and that by thus displacing each angle, we shall produce eight triangular planes, which are smooth and brilliant: we shall moreover find that it cannot be cleaved, so as to produce a brilliant plane in any other direction.

Fig. 1.

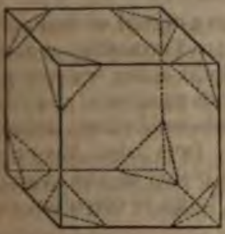
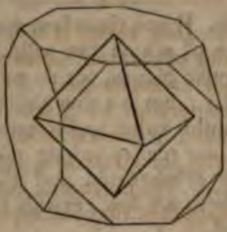


Fig. 2.



§ 33. Then let the *lines* of fig. 1. represent a cube, and the *dotted* lines, the triangular planes produced by cleavage.

§ 34. The cube having its solid angles displaced, is also represented in fig. 2. If however we pursue the cleavage by which we produced the triangular planes, that is, if we take away layers or laminæ parallel with those planes, we shall reduce the volume of the crystal by degrees, and shall finally change its form: for we shall ultimately find that the eight triangular planes of the cube will become the eight triangular planes of the octohedron within it. Let us not fail to observe that the termination of each solid angle of the octohedron, forms, as it were, a point in the center of each plane of the cube.

§ 35. If we still go on, and take from each plane of the octohedron other laminæ, we shall thereby reduce its size, but shall not alter its form: hence the octohedron is considered to be the primary form of fluor.

§ 36. Every one of the laminæ we shall have taken off in this process, may be again subdivided; it may be broken into octohedrons, tetrahedrons, and acute rhomboids (§ 17).

§ 37. Assuming then the octohedron to be the primary form of fluor (§ 17), and knowing that all its laminæ may be divided into regular forms, is it not reasonable to conclude that the whole cube upon which we first began to operate, is composed of minute solids of a definitive form, *whatever that form may be*:* and since the cleavage is attainable only in the directions specified (§ 32), is there not reason for concluding that they must be arranged with perfect regularity?

§ 38. Hence *the cube* (which is therefore one of the *secondary* forms of fluor,) *appears to be the consequence of a regular arrangement, on the planes of the primary octohedron, of extremely minute solids, resembling each other in respect of form.* We may assume this without pretending to decide the precise form of those molecules or integrant particles.

§ 39. When therefore we describe a crystal of fluor, as being a cube of which the solid angles are (naturally) replaced by triangular planes, we do not describe it either truly or philosophically: but we thus describe it from motives of convenience: we might more aptly term it a cubo-octohedron, because the triangular planes belong manifestly, from what has preceded, to the octohedron, and the larger planes to the cube (§ 34). But there are few crystals to which terms so covenient could be applied.

§ 40. Let us take one more example, in which the regular octohedron is the primary; this will also apply to fluor.

* *Whatever that form may be.* If the form of the *integrant molecule* is to be determined by mechanical division, we have in the instance of fluor three different solids (§ 17) presented to our choice; in blende five different solids (§ 18). The Abbé Haüy considers the regular tetrahedron as the integrant molecule of fluor; an opinion which is combated by Dr. Wollaston in his Bakerian Lecture (Phil. Trans. 1813). The object of this lecture is to shew the possibility that the integrant molecules may be *spheres* in some instances, *oblate spheriods*, in others. The whole subject may be considered as being at present involved in mystery, since the most acute and distinguished philosophers have not agreed in opinion.

These integrant molecules *whatever their forms may be*, are *compound bodies*; in fluor, they consist of *lime* and *fluoric acid*, which therefore may be termed the *constituent molecules*. Let us however pursue the subject one step further: these constituent molecules are *also compound bodies*; the lime is composed of *calcium* and *oxygen*, the *fluoric acid* of *fluorine* and *oxygen*; these, therefore, may be termed the *elementary particles*, or *elements* of fluor.

But the chemist has not even yet determined, whether fluor is to be considered as *fluate of lime*, or *fluoride of calcium*.

Fig. 1.

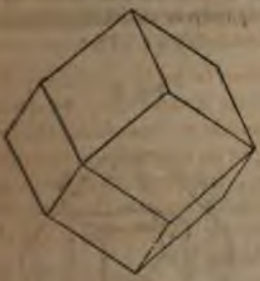
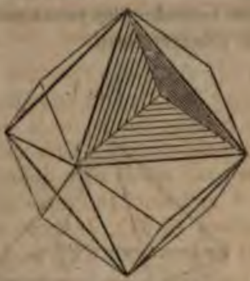


Fig. 2.



§ 41. Let fig. 1. represent a crystal of fluor in the form of the rhombic dodecahedron.

The same form is visible in fig. 2, and within it an octohedron; the lines of the latter being somewhat the darkest.

§ 42. Now we shall perceive by the latter figure that the rhombic dodecahedron is the consequence of an accession of crystalline laminæ composed of molecules placed in regular succession on every plane of the primary; the laminæ regularly diminishing in size until they arrive at a point, and producing on every plane of the octohedron, a low three-sided pyramid.

§ 43. On one plane of the octohedron in fig. 2, the laminæ, progressively diminishing and terminating in a point, are shewn by lines, and these lines or striæ are often visible in the rhombic dodecahedron, when the primary is an octohedron. Whenever striæ are seen on the planes of a crystal, they generally denote that it may be cleaved along them. They may be observed in dodecahedrons of fluor and the red oxide of copper, of which the primary is the regular octohedron; and if the substance does not yield to mechanical division, they sometimes serve as a clue to the determination of the primary form.

But it may be asked, how it happens, that if these laminæ progressively diminish, forming, as represented in fig. 2, a sort of step from one to the next, that the planes have sometimes a perfectly brilliant polish, without any of the roughness which in such a case might be expected. The answer is very simple. The molecules composing the crystal may be termed almost infinitely small, since *no limit has been found to mechanical division.*

§ 44. We have hitherto supposed the octohedron to be the primary: let us now take the cube, and suppose the octohedron and rhombic dodecahedron to be its secondary crystals, as they are found to be in several minerals; and we will afterwards consider the pentagonal dodecahedron as arising from the same primary form.

Fig. 1.

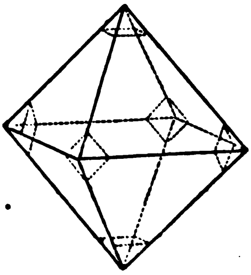
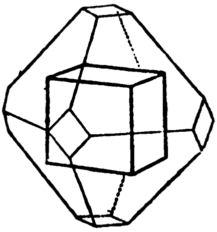


Fig. 2.



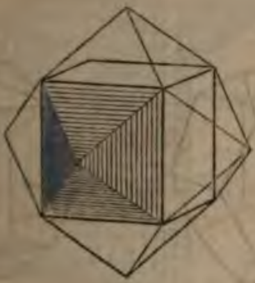
§ 45. Let the *lines* of fig. 1 be a regular octohedron, and let the squares formed by *dotted* lines represent the planes which would be produced by replacing the solid angles.

§ 46. In fig. 2 the octohedron is represented as having its solid angles replaced, and a cube within it. On considering the relations of these two figures, it will become manifest, that by pursuing the cleavage parallel with all the planes produced by displacing the solid angles of the octohedron, we shall ultimately convert that form into the cube. This might be performed in the instance of common salt, but crystals of it in the form of the octohedron are rare. If however we apply the knife, the pincers, or the hammer, to each of the solid angles of an octohedron of galena, we shall find that they may readily be taken off, so as to obtain a brilliant cube.

§ 47. It will also become manifest that by pursuing the division still further, that is, by taking off laminæ in the same directions, we shall only reduce the volume of the cube, not alter its form.

§ 48. If then the cube, which in this case is the primary crystal, can *only be cleaved into cubes* (as is the case with common salt and galena), we shall conclude that the octohedron, which is only a secondary form, has arisen from an accession, on every plane of the primary cube, of crystalline laminæ *composed of minute cubes*; the points of the solid angles of the cube being, in the preceding figure, precisely in the centre of the planes of the octohedron.

§ 49. Let us now consider the rhombic dodecahedron as arising from the cube; it has been considered as arising out of the octohedron (§ 41.)



§ 50. The figure on this page shews the rhombic dodecahedron, having within it a cube, of which the lines are darker than those of the former figure.

§ 51. On considering the relation of these two figures, we shall conclude that the rhombic dodecahedron, which is the secondary crystal, arises from the primary cube by an accession of crystalline laminæ on each plane of the cube, so as to form thereon a low quadrangular pyramid; and progressively diminishing in size, so as to terminate in a point. This pyramid, if the primary can *only be cleaved into cubes*, is assumed to be composed of cubic molecules, regularly arranged.

§ 52. These laminæ, progressively diminishing, are represented on one plane of the primary nucleus, and the same observations apply to the crystals thus formed as were made upon the rhombic dodecahedron arising out of the octohedron (§ 43). The striæ, it has been observed, sometimes denote the primary. In this case it will be seen that their direction is parallel with *the lesser diagonals of the rhombic planes*; and the existence of these striæ in the aplome, usually ranked as a variety of garnet, induced the Abbé Haüy to suspect its primary to be a cube.

We shall now proceed to consider the trapezoidal dodecahedron, as a secondary crystal of the cube, in other words, as arising from a regular deposition of crystalline laminæ on the planes of that solid.

Fig. 1.

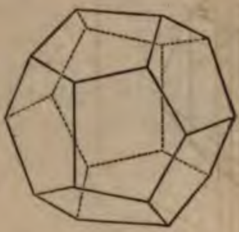
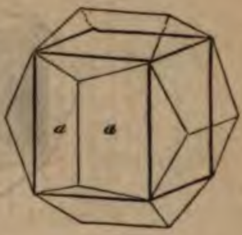


Fig. 2.



§ 53. Fig. 1 represents a trapezoidal dodecahedron; a solid bounded by twelve equal and similar trapeziums: it is sometimes termed the pentagonal dodecahedron, all its planes being five-sided.

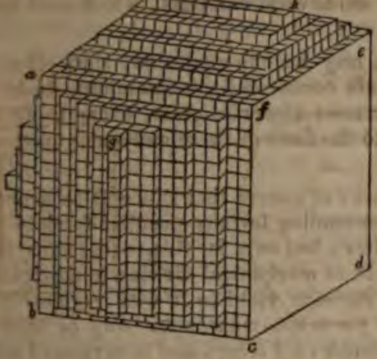
The same dodecahedron is also seen in fig. 2, having within it a nucleus in the form of a cube.

§ 54. We cannot fail to observe, that on each plane of the cube there is an equal and similar pyramid; and that each pyramid is not, as in the instance of the rhombic dodecahedron just described, composed of equal and similar planes.

§ 55. But, in this instance, the planes of each pyramid are equal and similar two and two. *a* and *a* resemble each other; and the two small triangular planes, the one above, the other below the planes *a*, *a*, also resemble each other.

§ 56. In this instance, therefore, there must necessarily be an arrangement of the little cubic molecules of which the crystal is assumed to be composed, very different to that which, in the instance of the rhombic dodecahedron, produced a precise uniformity. Here, between *a a* we have a line, but the four planes on each surface of the cube terminated, in the rhombic dodecahedron, in a point,—in a single cube.

§ 57. Let us observe whence this difference of form arises, on the assumption that the crystal is composed of cubic molecules.



§ 58. Let *a b c d e f* be the cubic nucleus, or primary crystal, composed of minute cubic molecules.

Then *a f e h n* will be one of the six pyramids on the planes of the cube.

§ 59. Now there is a remarkable difference in the arrangement of the cubic molecules on the two sides of this pyramid which are obvious to us; the same difference will consequently exist between the other two.

§ 60. On the side *a f h n*, which resembles the steps of a staircase, we shall observe that these steps are *two ranges of molecules in breadth*, and only *one in height.*

§ 61. But the very reverse of this is the case of the side *f e h*: for in this the molecules *are two ranges in height and only one in breadth.*

§ 62. The consequence of this difference in the arrangement of the molecules is, that the *quadrangular* sides of the pyramid incline much more upon the upper plane of the cube, than those which are *triangular*. Not so in the instance of the pyramids on the planes of the cube forming the rhombic dodecahedron (p. xvii); for in them, as in all the preceding figures, the superposition of molecules on the primary nucleus is *on every side* equal and similar, producing equal and similar planes, and precisely equal measurements in every direction. The structure in those crystals may therefore be termed *simple*: as the planes decrease *equally* to a point, they are said to arise from a *simple decrement.*

But the structure of the pentagonal dodecahedron may be termed *compound*, because its planes do not decrease *equally* on all sides; the *decrement is compound*. Of this species of structure there are several varieties, which will be noticed by observation.

§ 63. But it may be objected that, since the molecules of which crystals are constituted are too minute to be detected by the help of the most powerful glass, every thing which can be said in regard to the form of these molecules must necessarily be theoretical.

§ 65. It follows of course that this will be granted. We are not specially contending for any peculiar form in the integrant particles of matter; but only for this,—that since the crystals of a substance yield to mechanical division in particular directions, and cannot be made to yield to it with regularity in other directions, *these particles, whatsoever may be their form, must necessarily resemble each other, and be arranged with the utmost regularity; and also that this perfection of internal structure is the cause of regular external form.*

§ 66. This double regularity is proved by the goniometer, or measurer of angles. Of this instrument there are two kinds; that in common use was invented by Carangeau, the other, the reflective goniometer, by Dr. Wollaston. These instruments I shall presently describe, and afterwards subjoin a few remarks on their comparative value.

§ 67. The planes of the rhombic dodecahedron (p. xvii) meet each other under an angle of 120°, and those of the pentagonal dodecahedron (p. xviii), under different angles.

In the determination of the value of these angles, calculation has been resorted to, for the purpose of confirming the measurements obtained by the goniometer: and thus it has been decided that the *pyramid* formed on each plane of the cube, in the instance of the rhombic dodecahedron (§ 49), (being composed of planes which are equal and similar, and the measurement of any one upon the next, being uniformly the same), that those pyramids must be composed of laminæ superimposed in regular order on every side; namely, of *one molecule in height, and one in breadth.* But as the planes of the pyramid superimposed on each face of the cube, are dissimilar and unequal (or similar and equal only two and two) in the pentagonal dodecahedron (§ 55), so they afford different results under the goniometer, which have been confirmed by calculation; for by calculation it has been determined that the angles under which these planes meet, could *only be the consequence* of a superposition* of laminæ on each plane of the cube, of two molecules in height, and one in breadth on the one side, and of one in height and two in breadth on the other (§ 60). *And whether we assume these molecules to be cubes, or any other form, we must assume them to be equal to each other; and if so, whatever may be their form, the same structure would ensue.*

§ 68. By means of calculation the Abbé Haüy determined the angles under which the secondary planes meet, which result from an increase of laminæ on the cube and octohedron, and on other geometrical solids, considered as primary crystals: and thus, if we procure a portion of a crystal presenting only two planes of one of the varieties of those solids, we may decide which they are,—the use of the common goniometer will approximate the truth sufficiently to enable us to decide by a reference to his measurements; which may doubtless be relied on in every instance wherein the primary crystal is a perfectly geometrical solid, as the cube, the regular octohedron, the tetrahedron, the rhombic dodecahedron, and the six-sided prism: for, *the angles formed by the meeting of any two planes of these solids being accurately known, it follows that the angles of the secondary planes may be accurately calculated.*

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* It is a conclusion necessarily arising from the structure of crystals, that those which are secondary, result from a superposition on the primary nucleus, of laminæ, which are composed of regularly arranged molecules.

But the usual mode of describing the manner in which the secondary forms arise out of the primary, supposes the contrary to be the fact. The secondary crystal is described as arising out of the *replacement of the edges or angles*, or both, of the primary crystal.

Thus in the instance of Red Copper, p. 306, it is said that the primary is an octohedron; that fig. 6 arises from the *replacement of its edges;* but fig. 6 is in reality the consequence of a very opposite cause—of an *increase of laminæ on the planes of the octohedron*, the laminæ diminishing progressively in width. Fig. 7 is described as the consequence of a deeper—fig. 8 of a complete, replacement of its edges, by which the octohedron is converted into the rhombic dodecahedron—when, in fact, these crystals arise from an increase of laminæ *on the planes*, progressively diminishing to a point (§ 43).

It may be inquired, why, in these descriptions, a mode is adopted which is diametrically opposed to fact. The reply is, that it is convenient. If the fact were adhered to, the descriptions would be long and scarcely intelligible; and in effect it matters not which method is adopted, for the same consequence is arrived at in either case.

If the beginner would convince himself of this assertion, I would propose to him the following method. Let a piece of wax or of soap be moulded or cut into the form of the octohedron; then let each edge be equally cut away (*replaced*) by a knife, and the ultimate consequence will be the rhombic dodecahedron. Let then those solid angles of the dodecahedron which are formed by the meeting of three planes, be in like manner replaced by a knife, and the consequence will be, that in lieu of each there will be a triangular plane: if these triangular planes (eight in number) be increased by deeper replacements parallel with each, the ultimate consequence will be the conversion of the rhombic dodecahedron into the octohedron. And thus the assertion will be proved, that *whether we describe this secondary crystal as arising from the replacement of the edges of the primary, or from increase on its planes, the effect is the same.*

I venture to recommend this practice to the beginner, not simply as regards this fact, but also as a pleasing method of convincing himself of the transitions of crystalline forms.

§ 69. There are other primary forms which are not regular geometrical solids; for instance all those varieties of the octohedron of which the sides of the planes are not equal and similar; the primary octohedron of the oxide of tin is flatter than the regular octohedron, and that of sulphur is more acute. The varieties of the parallelopiped also are not regular geometrical solids, amongst which are the several acute and obtuse rhomboids, and all those solids whose bounding planes are equal and similar two and two, as the several varieties of prisms. The measurements assigned to several of these by the Abbé Haüy, are not perfectly correct, as has been proved by the reflective goniometer.

§ 70. Hitherto we have been treating chiefly of that structure which may be termed *perfectly crystalline*; this structure exists in those minerals which admit, in various directions, of regular mechanical division.

There are however other kinds of structure observable. In some minerals the natural joints are scarcely attainable, or when attained are only perceptible by the assistance of a glass; in these the structure is said to be *imperfectly lamellar*, and this effect may be supposed to arise either from the brittleness of the mineral, or from the strong cohesion existing between the laminæ. Such minerals may be said to be *imperfectly crystalline*, as may also those of which the planes obtained by mechanical division are curved or undulating. It has already been observed that some minerals are perfectly lamellar in one direction *only*, as the topaz for instance; others cleave readily in one direction, with difficulty in another, as the sapphire.

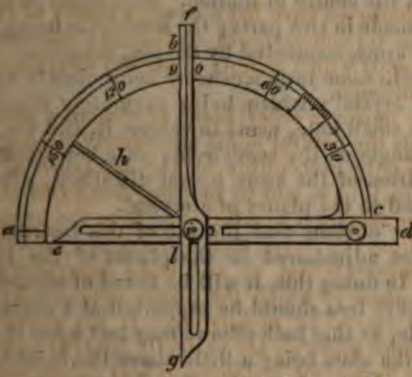
§ 71. The *fibrous structure* which some minerals assume, may in most cases be considered only as resulting from the close longitudinal adherence of small, or of extremely fine acicular crystals; for the terminations of the crystals are often observable on the exterior of the mass.

§ 72. Perhaps also under the head of Structure may be classed the variety of appearances assumed by the aggregation of small crystals. When merely collected, as it were, into a bundle, they are said to be *fasciculated*; when they are fasciculated and diverge from a common center, they are said to be *scopiform*; but when the divergence surrounds the centre, they are said to be *radiated*, or *stellated*.

§ 73. The term *slaty* as it regards *structure*, is rarely applied to those minerals of which we have been treating, even when, as in common slate, they are separable only in one, or at most two, directions. This term is more commonly applied to such substances as consist of parallel layers which are thick and coarse.

§ 74. The *granular structure* arises from an aggregation of small particles, frequently of laminæ which separately are lamellar, intercepting each other in every direction. And in proportion to the fineness of these particles, a mineral is termed *coarse-grained* or *fine-grained*. If the particles are only perceptible by the help of a glass, the mineral is said to be fine-grained: but if the parts of which a mineral is constituted be not thus apparent, it is said to be *compact*.

Of the Common Goniometer.

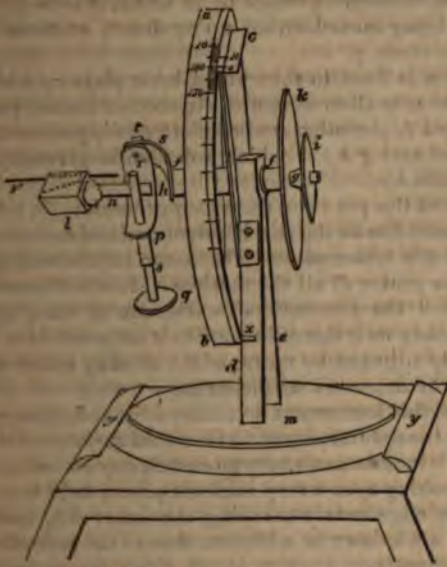


The common goniometer, or that invented by Carangeau, consists of a brass or silver semicircle *a b c*, graduated into 180 degrees (in the above figure the graduation is only partial), each degree being marked on the instrument by a short line extending from the outer rim, to the circle which is about $\frac{1}{10}$th of an inch within it: *d e*, and *f g* are two steel arms, the horizontal one being fixed, the vertical, moveable; beneath the arm *d e*, there is a plate of steel or of brass which is attached to the semicircle near *c*, and extends somewhat more than half-way towards *a*, its termination being connected with the semicircle by the bar *h* for the sake of firmness: *i* is the head of a pin in the centre of motion, which is precisely mid-way between the two extremities of the semicircle *a c*, and at the same distance from *b* as from *a* or *c*. The pin passes through both arms and the brass plate; and on this pin the arm *f g* is at pleasure moved by the finger. The upper part of the arm *f g* cuts the semicircle, in the above figure, precisely at 90 degrees, expressed by 90°: if then two faces of a cube were presented to the lower portions of the two arms *g l* and *l e*, it would be found to fit them accurately, since the planes of a cube always meet each other at the angle of 90°. But if the solid be less or more than that angle, the instrument may be accommodated to the angle at which the two planes may meet, by altering with the finger the moveable arm *f g*, if applied near its termination *f*; and the value of the angle will be indicated by the edge of the moveable arm.

As this goniometer is here figured, it is adapted to the planes of a crystal free from its gangue: but if the crystal be small and surrounded by obstruction, the two arms may be drawn by the ends *d* and *f*, (the cavities in the arms permitting them to slide), so that the points *g* and *e* will be very much nearer to the pin which is the centre of motion. Sometimes however this goniometer is made in two parts; the semicircle being one of them, and the two arms, connected by the pin, the other. In that case, the arms are in some instances more conveniently applied to the planes of a crystal; which being accurately done, the pin is dropt into a small hole, made to receive it, and the arm *f g*, indicates the angle on the semicircle; care being taken, that the relative position of the arms be not disturbed, after they have been adjusted to the planes of a crystal.

It must be obvious that the use of this instrument depends on its precise adjustment to the planes of the crystal to be measured. In doing this, it will be found of advantage that the common pocket lens should be supported at a convenient height above a table, so that both elbows may rest upon it while taking the angle; the glass being a little above the height of the wrist when the hands are elevated. For this purpose, a card rolled up and stuck by one end into the nozzle of a candlestick, and the handle of the glass placed in the hollow of the card, will be found useful: for the glass will be nearly upon a level with the eye. If then the crystal be placed behind it in the focus, the adaptation of the goniometer will be observed with advantage: and *unless the light be excluded from between the instrument and the crystal*, the adaptation will not be complete. If this cannot be accomplished, it may be concluded that the crystal, how perfect soever its planes may appear, is not sufficiently regular to be relied on, if perfect accuracy be desirable.

Of the Reflective Goniometer.



a b, is a moveable circle graduated on one edge to half degrees, and divided for convenience into two parts of 180 degrees each: (it is graduated only in part in the above sketch.)

c is an immoveable brass plate screwed upon and supported by the pillar *d*, and graduated as a vernier.

f f is the axle of the circle *a b*, and passes through the upper part of two brass pillars *d e*, the other ends of which are inserted into a wooden base *m*.

g h is an axle enclosed within *f f*, and turned by means of the smallest circle *i*, which communicates a motion to all the apparatus on the left of *h*, without moving the principal circle *a b*.

k is a circle to which is attached the axle of the principal circle. If therefore we would move the latter, it will be done by moving *k*; and as the axle of the principle circle includes that of the apparatus on the left of *h*, we necessarily give a motion to the whole instrument, by moving the circle *k*.

These two movements being understood, let us now suppose that we want to measure a crystal; a rhomboid of carbonate of lime for instance.

Let l be the rhomboid, attached by means of wax to one end of a plate of brass n; the other end of the plate being pressed firmly into a slit in the upper part of the circular brass stem o, which passes through the tube p, to which it is so adjusted as to allow of being moved either up or down, or circularly, by means of the circle q.

The tube p is fixed to the curved brass plate r, which is attached, but so as to allow of motion, to another curved plate s, by means of a pin t: the other end of plate s being connected with the concealed axle $g\ h$, to which a motion is given by turning the little circle i.

By means of the pin t and the tube p, therefore, we have two motions, in addition to the two before described as belonging to the axles of the instrument. The inner axle however may be said to be the centre of all the motions. It will therefore be of advantage that the rhomboid of carbonate of lime should be placed as nearly *on a line with that axle* as possible: this will be sufficiently adjusted by means of the stem o, which admits of being raised or depressed at pleasure.

The use of this instrument depends on the reflecting power of the polish on the natural planes, or fractured surfaces of minerals: and that this is in some cases very powerful, any one may convince himself by looking upon a very brilliant plane, held beneath the eye, with its edge nearly touching the lower lid, and not far distant from a window; he will then observe the reflection of the bars very distinctly.

Let us then suppose the goniometer, as above represented, to be distant from a window from 8 to 20 feet; let v be a *black line*, (the use of this is essential) drawn on the wainscot between the window and the floor, and *perfectly parallel* with the horizontal bars of the window. We are now by means of the circle k, to turn towards us the principal circle, until it is arrested by the stop x on the pillar d; it will then be found that 180 on the principal circle, coincides with o on the vernier.

If then the eye be placed almost close to the rhomboid l, the bars of the window will be seen on its plane; any one bar must be selected for the experiment.

Let us suppose the reflection to be seen in the direction of the lower dotted line on the plane; but as that line is not parallel with the bar of the window, and the black line v, the position of the rhomboid must be altered in order to make it so. This may perhaps be done by slightly drawing to the left, the circle *q* which communicates motion by means of the pin *t*; or perhaps it may be done by giving a circular motion to the stem *o*. By one of these two motions, or by both, it may certainly be effected.

If however the reflection appears to be like the upper dotted line, that is, parallel with the black line *v*, we must first convince ourselves that it is so, simply by depressing the crystal a little by means of moving the little circle *i*, so as to bring the reflection *upon the black line.*

This being adjusted, which must be done precisely, we then turn the crystal by turning the little circle *i*, until the reflection of the *same bar* be seen on the next plane, perfectly on a line with and upon the black line *v*.

However, in adjusting the second, we may disturb the first reflection. By perseverance it will be found that both can be adjusted by means of one or other of the movements by the stem *o* or the pin *t*, or by the help of both, and a short experience will do away the chief difficulties.*

Both reflections being precisely adjusted with the black line *v*, we have now to observe that the line at 180 or *o* forms a line with that at *o on the vernier*, *at the same time that the reflection of the bar is seen along the black line.*

One movement more, and the measurement will have been made. Turn the circle *k*, until the reflection of the *same bar* is seen on the adjoining plane *precisely upon the black line*, *v*: and the operation is completed.

We must now observe what line of the principal circle touches that at *o* in the vernier. Suppose that 105 on the former, be now on a line with *o* on the vernier;—it is the value of the angle. But suppose it to be a little more than 105 and less than 105½: it must then be observed *which line of the vernier touches, or forms but one line with*, another line on the principal circle: suppose it to be 5 on the vernier: the angle is then 105.5, which is the true value of the obtuse angle of a rhomboid of carbonated lime.

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* In using this instrument, I have found it convenient to substitute for the brass plate *n*, a piece of wax from half to three-fourths of an inch long, and of which one end is fixed to the upper part of the stem *o*, the other projecting from it on the left, so as to attach the crystal to it, either by placing it on the wax itself, or by means of a small portion of wax placed on the crystal so as to form a stem to it. I have also found great convenience in beginning the operation of measuring a crystal with the stem *o* in a vertical position, and by placing the crystal, when the stem is in that condition, so that the surface of one of the planes to be measured, shall be in a horizontal position; the other beyond the sight, towards the window. This plan allows of a ready means of adjusting the reflections on the two planes; for if that plane should want adjustment which shews the reflection when the stem o is vertical, the stem *o* may be moved to the right or left as the case may require; but if the other plane, then it will be most easily adjusted by giving a circular motion to the stem *o*, by means of turning the circle *q*, as above described.

I have been the more particular in the above description from being aware that the use of this elegant instrument is commonly considered to be extremely difficult; and that it is by some supposed that in taking an angle, it is essential to keep the head in one position, which will clearly appear not to be requisite. We may on the contrary perform any part of the operation, and after the lapse of hours complete it.

It may not be amiss to subjoin a few hints connected with its accurate use. In the first place it should be observed that when the circle is arrested by the stop *x*, the line at 180° on it is precisely on a line with that at *o* on the vernier: this must be exact.

Some difficulty will at first be found in attaching the fragment or the crystal to the wax (which must be warmed), nearly in the required position. In doing this, it will be found of some advantage to follow the rule given in the preceding note, and to begin with some substance which is brilliant, not more than one-third of an inch in diameter, and of which the angles are known. Fragments of transparent calcareous spar, or sulphate of barytes, are well adapted.

The perfect steadiness of the instrument is essential. A small, square, and very solid table, standing firmly, will be useful: but this may not be high enough to raise the instrument to the eye of the observer without supporting the goniometer, which must be so fixed as not to shift its place while moving the circles, or by a casual touch. Supposing the table to be of the ordinary height, some support for the goniometer a foot above it, will be requisite to elevate it to the eye of an observer while sitting. This support should be made in the form of a pyramid with a perfectly flat base, and a truncated summit, on which the goniometer may stand, or rather may be fixed, by sliding its wooden base *m* along it, so that, in two opposite places, it shall be confined by two pieces of wood *y y*, hollowed for the purpose of receiving it. This pyramid will afford an opening in the upper part for the goniometer when out of use, while the lower may be conveniently occupied by a drawer.

Of the comparative value of the Common and Reflective Goniometers.

The use of the common goniometer depends on two circumstances; one, the perfection of the crystalline planes; the other, the steadiness and accuracy of the hand and eye.

We are but little acquainted with the works of nature in her more hidden processes, amongst which may be reckoned crystallization; but it can be demonstrated beyond dispute that the surfaces of large crystals are not so uniformly even, however brilliant they may appear, as the surfaces of small ones. Now the larger ones are best adapted for the use of the common goniometer: hence, if the crystal to be measured be not selected with the utmost care, and if the hand and eye be not steady and accurate, we cannot hope for precision in the use of it; we cannot expect that precision which ought to exist, since *this mechanical operation is to form the foundation for calculation.*

That the planes of small crystals are more perfect than those of large ones, is proved by the use of the reflective goniometer, which depends on the perfection of these planes, and on their brilliancy. Even the minute crystals, which generally are the most perfect of all, rarely agree in the angles they afford; but this disagreement is commonly *too small to be detected by the common goniometer:* a fact, which clearly proves that its use cannot be relied on, as a foundation for calculation.

This disagreement may be assumed to be the consequence of some disturbance existing in the menstruum from which they were deposited, causing an irregular deposition of laminæ on the surface, which, though it be not perceptible to the eye, prevents that perfect reflection which would be the consequence of perfect regularity. But if we cleave a crystal, however large, carbonate of lime for instance, if it be pure and transparent, we shall find by the help of the reflective goniometer, that the planes of the primary nucleus which will be extracted, meet invariably under angles of 105°.5′. and 74°.55′. But the angles of this rhomboid, taken by the common goniometer, by perhaps the most skilful hands which ever used it, by the Abbé Hauy and the Comte de Bournon, are given by the first as 104°.28′. 40″ & 75°.31′.20″; by the second, as 101°.32′ & 78°. 28′;—a want of agreement in itself sufficient to assure us that the common goniometer is not to be relied on, where accuracy is required. When, therefore, we would arrive at the greatest precision, we shall prefer the reflective goniometer, and the reflections from the planes of minute crystals in preference to those from large ones, but above all from planes produced by mechanical division, whenever they can be obtained.

Now the surfaces produced by cleavage are sometimes very small, and therefore are not adapted to the instrument in common use; while for the reflective goniometer, it matters not if the surface should be very small, provided it be perfect and brilliant: a surface of the 100th part of an inch in length and breadth will suffice.

In speaking of the precision with which the angles ought to be taken, it was just now observed that it is essential, because this mechanical operation is a foundation for calculation; that is, for calculating the angles under which the secondary planes of a crystal meet each other; which, when once the first operation has been well conducted, is perhaps the shortest and most certain mode of arriving at the truth. In this the labours of the Abbé Haüy have shed over mineralogy a purely philosophical lustre, which indeed has been one of the chief causes of raising the study to the rank of a science: this he has done by shewing the consonance of the laws of crystallization with rigid calculation: he has proved that in crystallization there is a *natural geometry*.

That the angles of some other primary crystals, as well as those of the rhomboid of carbonate of lime, have been inaccurately determined by the Abbé Haüy, has, as it appears to me, been clearly proved. It will be understood from what has preceded (p. xi) that I now allude to such as are not regular geometrical solids: and whenever the means may be devised of procuring by mechanical division smooth and brilliant surfaces, however small, the true value of these angles may be found by means of the reflective goniometer.

Fracture.

An important part of this subject has already been considered under the head of Structure—namely, that which treats of the geometrical forms into which some minerals may be cleaved; and the means (p. x) of attaining this have been adverted to.

But when such minerals as may be mechanically divided along their natural joints, are broken in directions contrary to those joints, the surfaces so produced are not plane; they are said to be *conchoidal* when the surface more or less resembles the appearance of a shell; thus, we have the perfectly, imperfectly, large, small, and flat conchoidal. These varieties of fracture also exist in minerals, which appear not to possess any regular internal structure. In the latter also there are other kinds of fracture; as the *even*, when the surface is nearly flat; the *uneven* when it is not flat; we have also the *splintery* fracture, which sometimes is small, and perceptible only by the help of a glass, discovering small and somewhat pointed portions of the fractured mineral adhering to it by the larger end. The even and uneven sometimes also are visible as the *cross-fracture* of minerals possessing regular structure.

When a mineral breaks with a peculiarly uneven surface, somewhat similar to pure copper for instance, the fracture is said to be *hackly*.

Frangibility.

The frangibility of some minerals may in some sort be said to depend upon their structure; in all, it is probably dependent on some peculiarity in the arrangement of the molecules or particles of which a mass or a crystal is composed.

From whatever cause it may proceed, this quality varies greatly in different minerals, ranging through all the intermediate degrees, from *very brittle*, to *very tough*.

Some few minerals, as sulphur for instance, are so very brittle, that a fragment is very easily detached by the pressure of the nail on the edge of a broken surface: but as this may be produced in any direction, it cannot be said to depend on the structure of the substance.

The laminæ of selenite are readily separable in one direction; and if they be very thin, are brittle in another direction, while in the same direction, if the specimen be a line or more in thickness, it is very tough; heavy spar is pretty easily frangible in every direction; so also are calcareous spar and fluor. But, frangibility, strictly speaking, ought not to be considered as connected with the ease or difficulty with which minerals yield in directions parallel to their natural joints: it seems rather applicable to the ease or difficulty with which they yield to mechanical force in other directions. If this quality depended on regular cleavage, we should say that corundum is very brittle, because it yields along its natural joints with ease; and we should characterize the diamond as moderately brittle, because it can be cleaved with but little force: but in contrary directions, these substances are far removed from either brittleness or toughness.

Sulphur and the sulphate of lead are very brittle; carbonate of lead, red silver, grey copper, and others, are moderately brittle, and easily frangible in every direction. From these, fragments are easily detached by the pressure of the knife; other minerals yield only to a blow with a hammer. Others again are said to be tough, because instead of breaking, their particles only yield to the force, and by sliding, as it were, over one another, suffer depression without yielding fragments. Granular selenite is considerably tough; massive hornblende is very tough. In using the hammer, it will be found that a smart blow from a small one, will produce more effect, and better surfaces, than a heavy blow with a large hammer.

It may be observed that most of the porous minerals, and perhaps there are few which are not so, are much more frangible when first taken from their native bed, than after exposure. Of this common flint, in which no regular structure has been observed, is a remarkable instance. This circumstance is doubtless owing to the water which fills its pores when in its native place, but which evaporates on exposure.

Hardness.

This, though a very important one among the characters of minerals, is not easily defined.

It may be assumed to depend on the mode, or the degree in which, the molecules or particles of a mineral cohere. It takes in the whole range from the liquid, to the hardest substance in nature, the diamond.

Mineral oil is *liquid;* elastic bitumen is very soft; steatite, selenite, and other minerals which *yield to the nail*, are also very soft.

But, in order to mark the degrees of hardness with greater accuracy, a very imperfect attempt has been made to form a sort of system founded on the *relative hardness* of minerals; but it must be acknowledged that this, if carried to the extent of which it is capable, would be of great use.

Elastic bitumen, steatite, selenite, calcareous spar, fluor, felspar, topaz, quartz, ruby and diamond are of different degrees of hardness; the second *scratches* the first, and the third the second, and the fourth the third, and so on; and there are still other degrees of comparative hardness made use of in mineralogical description; the more this is extended the greater will be its use, since there are many minerals considerably resembling each other in appearance, which if accurately compared in this respect, might perhaps be distinguished from each other by this character alone.

Common glass is often made use of as a standard of comparison, and is a very useful one. There are several minerals harder than the first five above quoted, which are not hard enough to scratch it. Felspar and quartz, as well as some minerals of inferior hardness, readily scratch glass.

Quartz and all the minerals exceeding it in hardness, as well as some that are inferior to it, *do not yield to the knife*, which also is frequently made use of as a term designating considerable hardness: though it is by no means an accurate one, since there are many minerals differing in hardness, which equally refuse to yield to it. Among such as *do yield to the knife*, its use is sometimes advantageous in regard to the comparative ease with which they yield; and this method often assists those who well understand the relative degrees of hardness, in recognizing a mineral.

Giving sparks with the steel, is often made use of as a test of hardness; but this is at best but equivocal. There are few substances, even among such as are harder than flint, which afford sparks so numerous and so brilliant.

The use of the hammer is by no means an adequate test of hardness. Fluor is easily scratched by quartz, but the latter yields to a blow of the hammer much more readily than some of the more compact kinds of fluor, when in mass: and there are some granular substances which readily yield to quartz, that yield only to repeated blows of the hammer, dependant perhaps on the degrees of mobility in their parts, from which arises a species of toughness.

Transparency.

This is not one of the most important of the physical characters of minerals, inasmuch as the degree in which light is transmitted through a mineral, often varies greatly in the same substance, and even in the same specimen. In description however, a mineral is said to be *transparent*, when objects can be distinctly and clearly perceived through it, *semi-transparent* when they are imperfectly seen, *translucent* when they are scarcely or not at all visible; but when from various causes, a mineral appears not to suffer the transmission of light, we may perceive, on holding it between the eye and the light, that it is *translucent on the edges;* but when this does not exist, the substance is said to be *opaque*.

Lustre.

This is a character of considerable importance. Lustre is of several kinds; and whatsoever lustre a mineral may possess, *internally*, it is generally pretty invariable in different specimens of the same species; although in crystallized substances it often differs very much, *externally*, even on the same specimen.

That which is peculiar to the metals in their pure state, is termed the *metallic lustre;* this belongs chiefly to opaque minerals, such as plumbago, among amorphous substances; and specular iron and grey copper among those which are crystallized: but this kind of lustre is not equally intense in all those minerals which possess it, inasmuch as it varies from shining to dull. In some minerals, however, there is a species of metallic lustre which is perceptible only when the substance is held towards the light in some particular direction, as in the Bronzite; it is then termed *pseudo-metallic.*

The *adamantine lustre*, which belongs to particular minerals, will be better understood by a reference to those substances to which it belongs, than by any description that can be given of it. It exists in the diamond, some varieties of corundum, and in sulphate of lead, among other minerals. It belongs only to such as possess a greater or less degree of translucency, and being dependant on their capabilities of reflecting and of refracting light, it may be supposed to be in some sort dependant on their structure.

The *pearly lustre*, in a greater or less degree, is observable on several minerals, though sometimes only in a particular direction; it rarely exists but in lamellar minerals.

The *silky lustre* is particularly observable in the satin spar, in malachite copper, and in other minerals of which the structure is fibrous; and the changeable play of light sometimes visible on a change of position in the mineral, induces the conclusion that the fibres of which such substances are composed, are in reality regular crystals, from the surfaces of which a reflection may be supposed to arise. The *chatoyement* of the cat's-eye may be assumed to be owing to the fine fibres of asbestus or amianthus, included in it. But no adequate cause has been assigned for that changeable play of light, so beautifully displayed in the moon-stone and the chrysoberyl; or the still more beautiful colours of the noble opal and Labrador felspar.

The *resinous lustre* in minerals resembles that which is observable on the fractured surfaces of the resins; the *vitreous*, resembles that of fractured glass: these belong chiefly to the surfaces produced by fracture in directions contrary to those of the laminæ, if the mineral posseses regular structure; some varieties of pitchstone are instances of the resinous, quartz of the vitreous lustre. The *waxy* lustre is observable in chert, the newly broken surfaces of which possess that lustre which belongs to bees-wax: it is rarely, if ever observable where regular structure exists.

When no particular lustre is observable, except such as arises from the mere polish of the natural surfaces, or of those produced by fracture, a mineral is described according to the intensity, as being *splendent*, *shining*, *glistening*, or *glimmering:* but a glistening or glimmering lustre only, often arises from the fractured surfaces of some minerals, merely because those surfaces are uneven, and consist of minute irregularly-disposed planes from which the light is unequally reflected.

In the absence of lustre a mineral is described as being *dull.*

Colour.

It seems requisite to notice colour, though in reality, it can scarcely be said to be of any importance among the characters of many minerals, since there are very few earthy substances, except the emerald, in which it can be said to be characteristic, and even in that instance there are several shades of the same colour. But in fluor, for instance, which is found of almost every shade of several colours, it would be absurd to quote those colours and their various shades, among its characters. In some instances we have varieties of a mineral under names very different to that of the mineral itself, merely from the colour, as in prase as a variety of quartz, chrysoprase of chalcedony. The colour of the former is by some supposed to arise from an intimate mixture of another substance in the mass; that of the latter is derived from a metallic oxide; and these oxides are for the most part the colouring matter of the earthy minerals, the earths being all white and colourless, when chemically produced in a pure state.

When a crystallized mineral includes a metallic oxide or any other substance which produces *no alteration in the crystalline forms* assumed by the mineral in its pure state, such an ingredient, whether it be the colouring matter or not, is considered to be only accidental.

Some of the metalliferous ores, however, vary so little in *internal* colour, that it may be said to form an important characteristic of some of them.

Flexibility.

This serves as one among the distinctive characters of the few minerals which possess it: that substance is said to be flexible, which, being bent, does not of itself resume its former shape, but continues in the form forcibly given to it. Talc is flexible; as is also the phosphate of iron of Cornwall; while that of New Jersey is brittle.

Elasticity.

Those minerals are elastic which after being bent, spring back to their former position. Mica is very elastic, and may by this character alone be distinguished from talc, which is only flexible.

Double Refraction.

Double refraction may be considered rather as a curious property, than as a very important distinctive character of those minerals which possess it. Every one who has paid the slightest attention to mineralogy knows of its existence in an eminent degree in transparent fragments of calcareous spar; and they will have perceived that the two images of a circle made with a pen upon paper may be made nearly to coincide, by holding a rhomb of the spar in a particular direction, and that they may be made almost to separate by another position. The cause of the phenomenon of double refraction is not understood, further than that it is the consequence of peculiar transmission of the rays of light, owing as it is conjectured to the structure of the mineral.

A pyramidal crystal of transparent quartz may be held in such a position that if the head of the pin be placed against the undermost side of the prism, it will be visible on three planes of the prism and on three of the pyramid at the same time; in this experiment it must not be forgotten that all the planes, except one, are inclined to that against which the pin is held.

Touch.

The touch, or *feel*, is very characteristic in a few minerals. The soapstone is *unctuous* to the touch. Chalk is said to be *meagre*, being dry and without absolute harshness. It is principally in these two respects that this character is used in description.

Taste.

The taste is sometimes made use of as a discriminating character in some few saline minerals, of which water is a solvent; in which case the palate may be resorted to as a test of their nature.

Odour.

The odour of a mineral is a character of very restricted use. When swinestone is struck forcibly or rubbed against another and a harder substance, it gives out a peculiarly fœtid odour; and some argillaceous minerals give out the argillaceous odour when breathed upon. (See Alumine.)

Streak.

This character, which cannot be said to belong to minerals in the general, depends strictly speaking on the colour which is left upon paper by the pressure of a mineral along its surface. Thus plumbago gives a lead coloured streak. By some, however, it has been used to denote the colour of the powder which is produced by scratching the mineral with an instrument harder than itself, as with a point of a knife, but this rather belongs separately to

Powder,

The colour of which may be more accurately ascertained by reducing a portion of a mineral in a mortar or by the hammer. It is occasionally used among the distinctive characters of some of the metallic minerals which possess considerable resemblance to each other in the mass.

Adhesion to the Tongue.

This character depends on the disposition of a mineral to imbibe moisture. Lithomarge adheres strongly to the tongue; as do some substances which are supposed to be in a state of decomposition, as some varieties of chalcedony and opal.

Magnetism.

This character is confined with very little exception to some of the ores of iron, amongst which there are very perceptible degrees of difference in their power of attracting the magnet; dependant on their several states of oxidation, or upon their being constituted of iron differently oxidized. The oxydulated iron is very strongly magnetic, and possesses *polarity*; the specular is magnetic in a much less degree, and the red hæmatite is sometimes very feebly so. Carbonate of iron is considerably magnetic. Iron, cobalt and nickel are the only metals which possess the property of magnetism, and whenever other substances appear to possess this property, it is commonly owing to the presence of slightly oxidized iron.

The *black oxide*, or *protoxide of iron* consists of iron 100, oxygen 28.8. The *red oxide*, or *peroxide of iron*, of iron 100, oxygen 43.2. Strongly magnetic iron ore is in the state of protoxide, sometimes the protoxide and peroxide are intermixed in the same mineral.

A common magnet has two poles, a north and a south pole. If the north poles of two magnets be presented to each other, they repel one another, and the same effect ensues if the south poles are presented together. But the north pole attracts the south pole, and the south the north; and hence, when a mineral is presented to the magnet, which attracts the one and repels the other, it is said to possess *polarity*.

But in order to determine this point, it is advantageous to employ a needle of feeble power; for if the magnetic power of the needle be greatly superior to that of the mineral, the latter will attract both poles of the magnet: which has been explained in this manner:—it is said that the superior power of the needle produces in the mineral a polarity contrary to its own.

Electricity.

It will be recollected, that there are two kinds of electricity, which are called positive and negative, or vitreous and resinous, according as they are produced by exciting smooth glass, or any resinous substance. It will also be recollected, that, when two bodies possess the same kind of electricity, whether positive or negative, they repel each other; but if one possess positive electricity and the other negative, they attract each other.

A considerable number of minerals may be rendered electric by friction with the hand or woollen cloth; and when thus excited, they are capable of attracting light bodies, or of moving a delicate electrometer.

Among the minerals which are capable of exhibiting electric properties, there are a few which acquire electricity by being *heated*, either by simple exposure to a fire, or by immersion in hot water. But those minerals which are excited by heat, acquire, at the same time, both positive and negative electricity; but so separated, that, on whatever part of the mineral the positive may appear, the negative will be found on the part diametrically opposite. Thus if positive electricity appear on one side, or at one extremity of a crystal, negative electricity will exist on the opposite side, or at the other extremity. And it is very remarkable, that, in crystallized minerals, excitable by heat, the opposite parts of the crystal, on which the two electricities appear, are almost always different from each other in their configuration, or number of sides, although similarly situated in reference to the crystal itself. Thus if it be a prismatic crystal of tourmaline, and if the two electricities appear at the two extremities or summits of the prism, these two summits will differ from each other in the number or situation of their planes.* Most frequently that part of the crystal, which possesses positive electricity, presents the greater number of faces. On the contrary, it is usually the case, that, when a crystal does not become electric by heat, the opposite parts are similar. Sometimes certain angles or faces possess positive electricity, while the opposite angles or faces exhibit negative.

It may be stated as a general fact, with very few exceptions, that stones and salts, possessing a considerable degree of purity, and having their surfaces *polished*, acquire positive electricity; but, if their surfaces are not smooth and polished, they may acquire negative electricity, as is the case with rough glass.

Combustibles, the diamond excepted, become negatively electric by friction. The diamond, whether polished or unpolished, always becomes positive.

Ores are usually conductors of electricity, with the exception of some metallic salts, which become positive by friction.

For observing the electricity of minerals the electrometer is the most convenient instrument.

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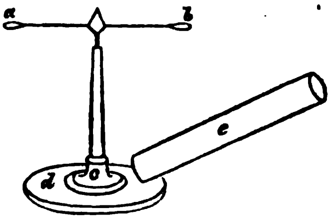
* The different configuration of the opposite parts of a crystal, exhibiting the two kinds of electricity, has been supposed to be a uniform fact. But more extensive observations seem to show, that it is not always the case. Some tourmalines from Pegu and Ceylon, which possessed both electricities, appear to have both summits perfectly regular and similar. Another exception appears in the dodecaedral crystals of the borate of magnesia. (Bournon.)



In this figure *a b* is a needle of copper, terminated at each extremity by a small ball, and moving very easily on a pivot at the center. At *c* the instrument has a metallic base. If a mineral, which has been excited, either by friction or heat, be presented near to one of the balls, the needle turns, whether the electricity be positive or negative; and the force of the electricity may be estimated by the distance at which the needle begins to move.

To determine which kind of electricity a mineral possesses, the needle must previously be electrified, either positively or negatively; which may be done in the following manner. Let the instrument be insulated by placing it on *d*, a plate of glass or resin. Having excited a tube of glass, or a stick of sealing wax, place one finger on the metallic base *c* of the electrometer, and then bring the exited glass or sealing wax *e* within a small distance of one of the balls of the needle. When the needle is sufficiently electrified, first withdraw the finger, and then remove the glass or sealing wax. If now an excited mineral be presented to the needle, they will repel or attract each other, according as they possess the same or opposite kinds of electricity. But, as the electricity of the needle is known, that of the mineral may be determined.

To ascertain the electric poles, or those parts of a crystal, which possess contrary electricities, let a thread or silk about one fourth of an inch in length be connected to one extremity of a rod of sealing wax, which must then be excited. To this thread of silk, which of course is negative, let the sides, angles, or summits of the mineral under examination be successively presented; and the attraction or repulsion observed will indicate those parts of the crystal, where the two electricities reside.

Sealing wax, when rubbed by most minerals, becomes negative. There are, however, a few minerals, of which sulphuret of molybdena is one, which, being rubbed on sealing wax, communicate to it positive electricity. In these experiments both the wax and mineral should possess smooth surfaces of considerable extent. (Introduction to Cleaveland's Mineralogy).

Phosphorescence.

This is a curious property rather than a useful character in the few minerals which possess it.

A mineral which gives out a light, either by heat or friction, is said to be phosphorescent.

Fluor, or still better that variety of it which is termed Chlorophane, is an instance of the first, and a variety of Blende of the last; if two pieces of quartz, or of the calcareous spar of Huel Goet in Brittany, be rubbed together, they emit sparks of light.

This character is of the less importance, because it does not seem to be essential to all those minerals which possess it, even in the greatest degree. According to Bournon some varieties of fluor are not phosphorescent.

The light emitted by phosphorescent substances is extremely variable in respect of colour. The best mode of exhibiting it in those which become so by heat, is, by first pounding them and then ejecting the powder on a shovel not quite red hot, in a dark room. Whatever colour a phosphorescent mineral may possess, it is generally lost by repeatedly subjecting it to heat, and the property of phosphorescing is also gradually diminished and ultimately destroyed.

This property, however, does not appear to be dependent on colour, or even connected with it, since the most perfectly colourless and transparent fluor which is found in the north of England, when powdered and thrown on a live coal, gives out a brilliant blue light.

Specific Gravity.

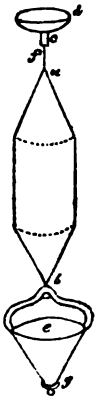
The specific gravity of a body is its weight, compared with that of another body of the same magnitude. Thus, if a cube foot of water weigh 1000 ounces, and a cubic foot of iron 7000 ounces, their comparative weights or specific gravities are, as 1000 : 7000, or as 100 : 700, or as 10 : 70, or as 1 : 7.

It is well known, that, when a body is immersed in water, it is in some degree supported by the water, and consequently loses part of its weight. This loss of weight is also known to be precisely equal to the weight of a quantity of water of the same magnitude as that of the body immersed. If then we weigh a body in air, we have its absolute weight; if we weigh the same body in water, we have the absolute weight of a bulk of water equal to that body; for it is equal to the weight which that body loses in water. We hence have the absolute weight of two different bodies of equal bulk; and the ratio of these weights is the ratio of their specific gravities.

For convenience, however, the weight of a given bulk of some substance must be assumed as a standard or unit, with which to compare the weight of the same bulk of all other bodies. In this case one number is always sufficient to express the specific gravity of a body, because the standard unit is understood.

For the purpose of a standard, distilled water is usually employed, a cubic foot of which weighs 1000 avoirdupois ounces. This, we have already seen, may be called 1000, or 100, or 10, or 1, adding decimals as far as necessary. If we assume 1 as the standard, the following proportion will give the specific gravity of all bodies heavier than water;—as the weight, which a body loses in water, is to its absolute weight, so is 1 to the specific gravity required. If the mineral be lighter than water, add the weight, which is necessary to make it sink in water, to its weight in air, and then say, as this sum is to its weight in air, so is 1 to the specific gravity.

On the preceding principles is founded the method of taking specific gravities by the instrument commonly called *Nicholson's Portable Balance.*



The body of this instrument is a hollow cylinder of tinned iron, of which each extremity *a* and *b* terminates in a cone. From the vertex of the upper cone a small stem of brass *a c* rises perpendicularly, bearing on its upper extremity a small tin cup *d.*

From the vertex of the lower cone is suspended a cup *e*, attached to a cone of lead underneath it *g*, as a ballast. Both the cups may be removed, when the balance is not in use.

When this instrument is placed in a vessel of water, a portion of the cylinder ought to swim above its surface. The tin cup *d* is then to be loaded with weights, till the instrument sinks so far, that the surface of the water may exactly coincide with a mark near *f* on the brass stem. The quantity, necessary to make the instrument sink thus far may be marked on the cup, as a given quantity for future use. Suppose this quantity to be 600 grains, which may be called the *balance weight*, and will serve for taking the specific gravity of any substance, whose absolute weight is not greater than that of the balance weight.

To ascertain the specific gravity of a mineral, place it alone in the upper cup, and add weights, till the mark on the stem coincides with the surface of the water; and suppose this to be 210 grains. Subtract the 210 grains from the balance weight of 600 grains; and the remaining 390 grains is the absolute weight of the mineral in air. Let the mineral be now removed to the lower cup; but, as it weighs less in water, than in air, the mark on the stem will rise a little above the surface of the water. Additional weights must now be placed in the upper cup, till the mark on the stem again coincides with the surface of the water. Suppose this to be 80 grains, which will of course be the weight of a quantity of water precisely equal in bulk to the mineral. We now have the absolute weights of equal bulks of water and of the mineral; then say, as 80 : 390 :: 1.000 : 4.875, the specific gravity.

If the mineral under examination be lighter than water, it must be confined, when weighed in the lower cup; and the weight of whatever confines it is to be regarded, as belonging to that of the instrument. In other respects the process is the same as the preceding. But, as the mineral is lighter than water, it is evident the second term of the proportion will be less than the first.

If the mineral very sensibly absorb water, which fact may be discovered by the gradual sinking of the instrument, after the specimen is placed in the lower cup, although no additional weight is put into the upper cup, the weight of the water imbibed must be ascertained by again weighing the mineral in air; and is then to be added to the first term of the proportion.

Some minerals are rapidly dissolved in water. In such cases some other fluid, as oil of turpentine, may be employed; or the water may be previously saturated with a portion of the same salt, whose specific gravity is to be taken.*

The specific gravity of minerals, belonging to the same species, often varies a little, either from the accidental mixture of coloring matter or other foreign ingredients, or from a more or les intimate combination of the component parts. But notwithstanding these variations, the character drawn from the specific gravity is exceedingly useful. For by taking the mean specific gravity of several specimens of the same species in a state of a great purity as can be procured, something like a standard of specific gravity for every species may be obtained. In crystallized minerals, not obviously impure, the variation from the mean will probably be within the limits of one fiftieth above o below. In substances not crystallized it must be greater, especially in certain species of ores. (Introduction to Cleaveland' Mineralogy.)

CHEMICAL CHARACTERS.

Although the chemical characters of a mineral are most full and completely understood by its analysis, there are othe means of arriving at some knowledge of its component principles: and therefore, though the methods about to be described do not make us well acquainted with all that is to be known they serve now and then to detect an important ingredient, an therefore add, by very simple processes, to the distinctiv characters: the means are chemical inasmuch as they produc a change, or partial decomposition.

Action of the Blow-pipe.†

The use of this instrument is somewhat difficult of attainment supposing it to be applied to the mouth (which is always sup posed unless the contrary be expressed) its use depends on the power of producing a constant and pretty uniform stream of air. This current is not supplied at once from the lungs. The mouth being filled, the communication between it and the lungs is to be closed by a peculiar action of the tongue, which is to be drawn back against the orifice, while the lungs are replenished through the nose; as the mouth becomes emptied, it is again to be filled from the lungs, and the communication closed as before, while the lungs are filling through the nostrils. The best mode of attaining the use of the blow-pipe, appears to me to be to sit down to it with no other object at first, than that of producing from the flame of a common candle, a steady stream of flame: taking care that the snuff be of a moderate length, and the top of it bent in the direction of the blast. The blow-pipe may be either of glass, partly of wood and partly of metal, or altogether of brass, having a bulb-like cavity near the centre of the stem, of which the principal use is to receive the saliva.

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* The preceding experiments are supposed to be made with distilled wat at the temperature of about 62° Fahr. But, when common water, at a different temperature, is employed, the true specific gravity of the mineral i distilled water, at the proper temperature, must be determined by calculation; for the method of which, reference may be made to treatises on hydrostatics.

But in those cases, where the greatest precision is not requisite, rain wate at a temperature near to 62°, will give results sufficiently accurate.

Fluid minerals are few in number and rare. For methods of obtainin their specific gravity, reference may be made as above.

† The student is particularly referred to the Treatise on "The use of t Blow-pipe in chemical analysis, and the examination of minerals, by Berzeliu translated by J. G. Children, F.R.S. &c. a highly useful and justly celebrated work.

The use of this instrument is highly interesting. If fusion be not produced, we have at least the advantage of seeing the impression that is made by a very powerful heat; of noting the appearances and consequences which gradually take place, and which often are very characteristic.

It will be observed that there are two cones of flame projected from the pipe; the outer yellow, the inner blue. The heat of the outer cone is less than that of the inner, and the most intense heat of the blue flame is near its point.

The substance to be acted on ought not to exceed the size of a grain of pepper; for if it be too large, a part of it will be without the focus of the heat, to which every part ought to be subjected alike. In most cases it will be advantageous to expose the mineral at first to the heat only of the outer flame.

Various methods, depending on the nature of the mineral, must be employed for supporting the fragment before the flame. Very small forceps will be sufficient, when the mineral has but little fusibility. For substances easily fusible, a small platina or silver spoon may be employed. It is important, that these metallic supports should be very small, that they may not absorb too much heat. When metallic oxides are to be reduced, a piece of very compact charcoal forms the best support. A small cavity is made in the charcoal, in which even minerals in a state of powder may be conveniently examined, especially if the cavity be partly covered by another piece of charcoal.

Minerals, while exposed to the action of the blow-pipe, exhibit very different appearances, which, being directly before the eye, are easily observed, and should be minutely described.

Sometimes their colour is changed, or entirely disappears. Some minerals decrepitate, others divide or exfoliate, when exposed to the flame. Some indurate and contract their bulk; others effervesce, or, rising in little blisters, melt with intumescence. It is also important to notice the vapour or odour, which may escape during the experiment; even the colour, which some minerals communicate to the flame, is to be regarded.

The degree of fusion, and the results obtained, are to receive attention. On some minerals the blow-pipe produces no effect whatever; others are partially fused; and others again melt with great ease.

The results of fusion may depend in some degree on the intensity or continuance of heat, as well as on the nature of the mineral. Some minerals by the action of the blow-pipe are merely softened, and alter their shape a little; or, if the substance be in loose grains, they become agglutinated. Others are converted into a kind of porcelain, in which only a few points are vitrified. Some melt into a *slag*, which is a compact substance, containing metallic matter; others yield a tumefied mass, or are reduced into a *scoria*, which is light and porous; and others give an *enamel*, which has a vitreous aspect, but is not transparent; sometimes the enamel is only superficial.

Many minerals, when melted, yield a globule of perfect *glass*, which, in different substances, has various colours, and possesses different degrees of transparency. Both enamels and glasses are sometimes porous or vesicular.

When minerals contain foreign ingredients, their fusibility and the appearance of the product may be much altered.

Certain substances called *fluxes*, are sometimes added to the fragment under examination to promote its fusion; and by their assistance many minerals, otherwise infusible, may be melted. There are some cases, however, in which the mineral, although not really melted, unites with the flux, in which it appears to be minutely divided and suspended, or even dissolved. It is to be remembered, that the appearances of the mineral during fusion, and also the results of fusion are variously modified by the action of fluxes. The same flux becomes differently coloured by different minerals; and different fluxes receive different colours from the same mineral.

One of the fluxes most commonly employed with the blow-pipe is the sub-borate of soda (borax). In some cases the [illegible] nicated to the flux by metallic oxides, may assist [illegible] he kind of acid present.

Action of Acids.

Although complete analysis be not the object in subjecting minerals to the action of acids, yet we may thereby obtain characteristic information in regard to many minerals, especially the acidiferous, and some of the alkalino-earthy minerals.

In this process it will often suffice that a small fragment of the mineral, or a portion of it reduced to powder, should be placed in a concave receiver, a watch glass for instance, and that it should be covered with diluted acid; for this purpose the muriatic is commonly used, but the nitric or sulphuric is sometimes employed. When effervescence ensues, it is important to notice the rapidity and degree of effervescence; in some minerals it is great and rapid, in others slow, and not very apparent: sometimes the solution is complete; sometimes a residue is left, and occasionally, as in some of the alkalino-earthy substances, the mineral becomes gelatinous. In most cases, the process is carried on at the common temperature of the air, in others, by the application of a gentle heat.

Hence, it will be concluded that in more than a few instances, the consequences of the action of acids, form an important feature among the characters of minerals.

Analysis.

It forms no part of our present object to describe the manner in which the Chemist pursues his researches. We look only to the results;—to the information which is to be derived from the labours of the chemist in regard to the number and nature of all the chemical elements of minerals which have hitherto been analysed.

Minerals may be divided into *Earths*, *Alkalies*, *Acids*, *Metals* and *Combustibles;* and it may be observed that every elementary body occurring in the other kingdoms of nature, with the single exception of iodine, enters into the composition of minerals; but many are of course peculiar to the mineral kingdom.

A mineral, chemically considered, may be said to be either *simple* or *compound:* simple, when it consists of a single earth, or of a metal; compound when by analysis it is found to consist of more than one substance; and in the latter case we might be inclined to term all the substances of which a mineral is constituted, its *elements*, but the term element has a signification which is not always applicable to these substances. Thus, we might say of fluor that its *elements* are lime and fluoric acid. Now lime is a compound substance consisting of oxygen united to a base which is by most chemists ranked among the metals; the other ingredient of fluor, the fluoric acid, is composed of fluorine and hydrogen.

Here however we must observe, that as the term *Element* is commonly used to express a *simple* substance—one that resists all the efforts of the chemist to separate it into two or more kinds of matter—it is plain that neither lime nor the fluoric acid can be considered as elements; although they certainly form the *constituents* of fluor.

If therefore we would form a catalogue of the elements of mineral substances, we should insert in it all the constituent principles of the earths, the alkalies, the acids, and of combustibles, and complete the catalogue by the addition of the metals: but from this plan we shall deviate a little. For, although the chemist has proved the earths to be compound substances, he generally treats of them under the old appellation of earths, instead of confining his views to them as metallic oxides, as we shall hereafter shew them to be; and in this view we shall consider them, because it is mineralogically convenient and distinctive. The same observation applies to the alkalies.

Adding therefore, the earths and alkalies to the list of simple bodies, we shall comprehend in the following the whole number of the

CONSTITUENTS OF MINERALS.

Oxygen
Chlorine
Fluorine
Nitrogen
Hydrogen
Carbon
Sulphur
Phosphorus
Boron
Selenium
Earths
Alkalies
Metals

We shall proceed to consider the nature of each of the foregoing substances separately; to which will be added some account of certain acids as mineral constituents; of water which in some few minerals is an essential ingredient; and of combustibles generally.

OXYGEN.

Oxygen has not been obtained in a complete state of separation: in the most simple form in which it has been procured, it is combined with heat, forming what is termed oxygen gas; thus united, it is essential to the support of animal life.

Oxygen gas may be obtained from many substances; it is most abundantly, and perhaps most readily, procured from the black oxide of manganese; which furnishes most of the oxygen used by the chemist, and is employed in preparing the oxymuriate, or chloride of lime consumed in the bleacheries of Britain and other countries.

All the substances from which it can be procured are considerably diminished in weight after yielding oxygen gas, which is rather heavier than common air: all bodies which absorb oxygen acquire an addition to their weight.

Oxygen was formerly considered to be the general cause of acidity; in other words, a necessary principle of every acid; and the term Oxygen is compounded of two Greek words, having allusion to that theory: but that theory has lately been done away, by direct proof of its being incorrect in two instances, which is further corroborated by the probability of its incorrectness in some others; and that certain bodies afford acids by combining with hydrogen. (See Acids.)

Oxygen, it is ascertained, is so abundant a principle in many minerals, particularly of those constituting the oldest and most plentiful masses of the crust of the globe, that it may be said to be one of the most common and most abundant of mineral elements, if not the most common and most abundant of all.

Of the most plentiful of all mineral substances, silex, it forms 50 per cent.; of alumine 47; of lime 28; of magnesia 40; of potash 17; and of soda 25 per cent.: to which it may be added, that it forms nearly 89 per cent. of water; and that in the ores of tin and manganese, and many of those of iron, lead, copper, &c. oxygen enters as an ingredient in various proportions.

Oxygen also forms an important ingredient in many minerals, as an essential element of certain acids; as in the two abundant substances the sulphate and carbonate of lime. It has been supposed that the latter alone constitutes one-eighth part of the whole crust of the globe. It may be assumed that limestone is composed of about 56 parts of lime and 44 of carbonic acid. Now lime consists of about 72 per cent. of calcium, and 28 of oxygen; and carbonic acid of about 28 per cent. of carbon, and 72 per cent. of oxygen; so that oxygen enters into the composition of the one-eight part of the crust of the globe, which is calculated to be constituted of carbonate of lime, in point of fact, nearly in the proportion of one half.

But argillaceous rocks are considered to be more plentiful than calcareous, and siliceous more abundant still. Of these rocks oxygen forms on an average nearly 50 per cent.: so that the calculation in regard to the proportion into which oxygen enters into the composition of minerals, would amount to a very large percentage of the whole crust of the globe.

CHLORINE.

It is the opinion of Sir H. Davy, and many other able chemists, that the oxymuriatic acid contains no oxygen, the presence of which its name implies; he has consequently changed its name for that of Chlorine, derived from the green colour which it possesses when in a gaseous form. Chlorine has never been decomposed. The muriatic acid consists of equal volumes of chlorine and hydrogen gasses.

Chlorine has never been found pure, in nature, but in common, or rock salt, it is combined with sodium in the proportion of 60 per cent.

The muriatic acid is found in small quantity in the sodalite, and one or two other earthy minerals: in combination with lead, quicksilver, and silver, in different proportions: of the arseniate and phosphate of lead, it forms about 2 per cent.

FLUORINE.

The last experiments of Sir H. Davy on fluoric acid, have induced him to believe that it is composed of hydrogen and a peculiar base which he has denominated fluorine. This substance, from its strong affinities and decomposing agencies, has not yet been exhibited in a separate state; nor have any attempts to detach it from its combinations been successful.

Fluor Spar is composed of about one-third of fluoric acid, and two-thirds of lime; but whether the compound exists as fluate of lime, or fluoride of calcium has not been determined; fluoric acid is obtained nearly in the same proportion from the cryolite; of the Saxon topaz and the pycnite it forms 5 to 6 per cent; it has not been detected mineralizing any metal except cerium.

NITROGEN OR AZOTE.

Nitrogen, in combination with caloric, when it is termed nitrogen gas, is one of the [illegible]nts of atmospherical air: from its unfitness for the [illegible] animal life, it is frequently called [illegible] compounded of two Greek [illegible]ve quality. It has since been called Nitrogen gas, because, by union with oxygen, it composes nitric acid.

It immediately extinguishes a lighted candle and even burning phosphorus, and is fatal to animal life.

The claims of nitrogen to be considered as a mineral constituent, are, that it enters into the composition of ammonia, one of the alkalies; and that, as a constituent of the nitric acid, which consists of about 26 of nitrogen and 74 of oxygen, it is of course an ingredient of nitre or saltpetre.

HYDROGEN.

The most simple form in which Hydrogen has been obtained, is that of a gas, in which it is in union with heat. From this combination it has not been separated except by taking advantage of its greater affinity for some other substance; in which case the hygrogen separates from the heat, and forms, with the body which has been added, a new combination. It is considered to be an elementary body.

Hydrogen is one of the component elements of water, of which it forms about 11 per cent.; its name is compounded of two Greek words, importing that circumstance; it is one of the elements of ammonia, and of the fluoric and muriatic acids. It is obtained in variable proportion, from several substances, and in combination with sulphur forming sulphurretted hydrogen, it has been detected by analysis, in the Haüyne or Latialite; the swinestone or stinkstone, a variety of carbonate of lime which is found in considerable abundance, is supposed to owe the peculiarly offensive odour which it gives out when scraped or rubbed, to the presence of sulphuretted hydrogen.

Hydrogen gas is emitted from the crevices of volcanic matter; and it is asserted by Brongniart, that near St. Barthelemi, which is not far from Grenoble in France, hydrogen gas issues from the crevices of a country which has no appearance of being volcanic; and consisting of a grey friable argillaceous schistus. The gas has no odour; and if inflamed, continues burning sometimes for many months: the surrounding mountains are calcareous. He likewise says, that similar circumstances occur in England, on the road between Warrington and Chester, and also near Brozeley in Shropshire.

Carbon.

The purest form in which *Carbon* is seen, is that of the diamond; and it was for a long time considered that the only chemical difference between this gem and charcoal is, that the latter contains some oxygen, and therefore is an oxide of carbon. But the late experiments of several chemists, and particularly of Sir H. Davy, tend to shew that there is no oxygen in pure charcoal; and that there is no decided chemical difference between it and the diamond. Charcoal, however, always contains either hydrogen or water in very small and variable proportions, but not as an essential ingredient: the diamond is absolutely free from hydrogen and water; and it is in this respect only, and in the mechanical arrangement of its particles, that there is any evidence of its differing from charcoal. The experiments of Allen and Pepys tend to prove that the actual quantity of carbon, in equal weights of diamond and charcoal, is precisely the same. If proof were wanting of the identity of carbon and the diamond, it is furnished by the fact that the diamond converts iron into steel, under circumstances quite free from all sources of fallacy.

Carbon forms the basis of several of the combustibles; as coal, bitumen, amber, &c.; and it enters into the composition of a few minerals in small proportion; in the Aberthaw limestone, the hepatite, semi-opal, and in clay-slate, not exceeding 1 or 2 per cent.; in rotten-stone 10 per cent.; and less than 1 per cent. in compact manganese: its most important mineral character is, that it forms the base of the carbonic acid, which enters into all limestone rocks, as an ingredient, in the proportion of about 44 per cent.: Carbonic acid consists of about 28 per cent. of carbon and 72 of oxygen.

Sulphur.

Sulphur is not only itself a highly inflammable body, but is also an ingredient of other combustibles; as of certain kinds of coal. Large deposites of sulphur are met with in some volcanic countries: it is found in considerable masses or in beds, both in primitive and transition countries, and it is largely involved in certain metallic ores; such as iron, copper, lead, antimony, silver, &c. which thence are termed sulphurets of those metals, and which, generally speaking, are the most abundant of all metalliferous ores; it is met with in one earthy mineral, the automalite, in the proportion of 17 per cent. Sulphur is the base of the sulphuric acid; which consists of 40 per cent. of sulphur, and 60 of oxygen. The sulphuric acid enters largely into the composition of that abundant substance, sulphate of lime or gypsum; and is likewise an ingredient of several other earthy minerals; and in certain metallic ores.

PHOSPHORUS.

Phosphorus is a highly inflammable substance usually of a flesh red colour, and very soft: its specific gravity is 1.77. In the atmosphere it emits a white smoke, and peculiar smell, and a faint light arises from it.

When phosphorus is acted upon by a powerful voltaic battery, it gives out a gas in considerable quantity, which proves to be phosphuretted hydrogen: hence it has been concluded that hydrogen is one of its component elements, but some of the late experiments of Sir H. Davy tend rather to contradict than confirm the conclusion.

Phosphorus is prepared by decomposing phosphoric acid with charcoal, which combines with its oxygen, and liberates the phosphorus. The phosphoric acid is first procured from calcined bones, which consist of phosphoric acid and lime, by means of sulphuric acid.

Lead, manganese, and copper, are found mineralized by the phosphoric acid, in proportions differing from 18 to 31 per cent.; it also occurs in combination with iron; and combined with lime, in the proportion of 50 per cent.

BORON.

Boron is a peculiar combustible substance, which has been obtained by subjecting crystals of boracic acid to the action of a voltaic battery. Its precise nature is not yet understood; though it is ascertained to be a substance differing from every other known species of matter.

Boracic acid consists of 27 parts by weight of boron, and 73 of oxygen.

The boracic acid enters into the composition of two rare earthy minerals, the boracite and the datholite; in the proportion of 83 per cent. in the former, and 24 per cent. in the latter. It has not been detected in any metalliferous substance; but it occurs in the proportion of 13½ per cent. in the borate of soda, or borax, which is abundant in a certain lake in Thibet.

Selenium.

This substance is of a grey colour, with a brilliant metallic lustre, and possesses a very slight degree of translucency. It melts at a temperature above boiling water, and evaporates in close vessels at a temperature a little below redness; when cooling it is ductile, may be kneaded between the fingers, and drawn out into fine threads, having a strong metallic lustre. When slowly cooled, it has a granular fracture, and resembles cobalt. Before the blow-pipe it volatilizes, giving out a strong smell of horse-radish, with which $\frac{1}{16}$th of a grain suffices to fill a large apartment. With oxygen it forms an acid, called selenic acid. It is ranked among combustibles.

It is doubted by some chemists whether it ought to rank among the metals; it is a bad conductor of caloric, and is a non-conductor of electricity.

It was discovered by Berzelius in the reddish masses, chiefly consisting of sulphur, deposited in the chambers for making sulphuric acid, from the sulphur procured from Fahlun in Sweden; and exists in the iron pyrites of that neighbourhood, from which the sulphur is obtained. We have no description of this pyrites.

EARTHS.

The Earths are ten in number, viz.

Silex,
Alumine,
Lime,
Magnesia,
Zircon,
Glucine,
Yttria,
Barytes,
Strontian,
Thorina.

Four of them, lime, magnesia, barytes and strontian, possess some of the chemical characters of the alkalies; by some, they have therefore been placed among the alkalies; others have called them *alkaline earths.*

The whole number were, until within the last few years, considered to be simple or elementary bodies, but Sir H. Davy has proved them to be compounds consisting of oxygen united with certain bases, some of which possess several of the characters peculiar to the metals; but the nature of these bases is not so well ascertained as that of the bases of the alkalies. The discoverer, however, considers most of them to be metals; and if this be admitted, the *earths are to be considered as metallic oxides.*

The four alkaline earths were much more readily decomposed, and their bases are ascertained to possess certain of the characters and properties of the metals, with greater certainty than the remaining six; which have a much stronger affinity for the oxygen with which they are combined. The alkaline earths were electrified negatively in contact with mercury, by which means amalgams were obtained, consisting of the metallic bases of the earths and of mercury. These amalgams may be preserved under naptha for a considerable time, but at length they become covered with a slight crust of the regenerated earth by absorbing oxygen.

The metallic base of barytes has been named *barium* by Sir H. Davy; that of strontian he denominates *strontium*; that of lime, *calcium*: for that of magnesia, *magnesium* has been proposed, but it is less perfectly known than the three preceding: the base of silex, *silicium*, has not been obtained in a state of separation; it was at first considered to be a metal, but "Sir H. Davy now believes it not to be a metal, but a substance most resembling boron; and, like it, bearing an analogy to charcoal, sulphur, and phosphorus." The base of alumine, *aluminum*, has not yet been produced in a state fit for investigation: that of zircon, or *zirconium*, is still unknown: as well as that of glucine, or *glucinum*; and that of yttria, *yttrium*, has not been exhibited in a separate form.

These bases are united with oxygen in different proportions. That of barytes is united with about 10 per cent. of oxygen; that of yttria about 20 per cent.; of strontian about 16 per cent.; that of zircon 18 per cent.; of lime 28 per cent.; of glucine 30 per cent.; of magnesia 40; of alumine 47; and of silex 50 per cent.

Of the comparative Ages of the Earths.

The earths are here placed in the foregoing order (p. liv) and the minerals of which they constitute the chief ingredients, will hereafter be noticed in that order, for the following reasons. Silex, alumine, and lime, are the principal constituents of the oldest primitive rocks. Magnesia also enters into the composition of a primitive rock, though not one of the most abundant. Zircon and glucine are in part the constituents of a few rare minerals which are imbedded in early rocks, or are met with in the veins of primitive mountains: in the veins of which, also, the minerals containing yttria, barytes, and strontian, occasionally occur.

Silex.

This earth is, when pure, in common with the rest of the earths, perfectly white; it has neither taste nor smell, and its specific gravity is 2.26.

It is infusible by the intense heat of voltaic electricity; but was melted by Dr. Clarke with the oxygen and hydrogen blow-pipe. Sir H. Davy first proved it to be a compound body, consisting of oxygen and a peculiar base, which he has termed *silicium*. Berzelius decomposed silex, by fusing it with charcoal and iron in a blast furnace. He obtained an alloy of iron and silicium, which by the action of a diluted acid, gave more hydrogen than an equal weight of iron.

Silex consists, according to Berzelius, of oxygen, in the proportion of about 50 per cent. united with the base, *silicium*, which has not hitherto been obtained in a state of separation.

Notwithstanding the complete analysis of silex, it still obtains among chemists its old denomination of an earth; principally, it may be supposed, from the difficulty of properly characterizing its base; which is not believed by Sir H. Davy to be a metal, but of a peculiar nature, bearing an analogy to boron, charcoal, sulphur, and phosphorus.

Silex has never been found mineralized by any acid, but is occasionally contained in small proportion in some of the acidiferous earthy substances; it forms a large ingredient of very many earthy minerals, including some of the hardest gems and the softest clays; it is proved by analysis to enter, in variable proportion, into the composition of about two-thirds of the whole number of earthy minerals whose composition is known; and as it is the chief ingredient of the oldest and most plentiful of the primitive rocks, and is found in rocks of almost every age and formation, it is esteemed to be the most abundant substance in nature.

As common flints are almost wholly composed of *siliceous earth*, it thence received the name of Silex, which in the Latin signifies flint; but it is found in the greatest purity in quartz or rock crystal.

Alumine or Argil.

This substance obtained the name of Alumine from its forming the base of common alum; and that of Argil, from the Latin, Argilla, clay, on account of its being a constituent of clays, though rarely in a greater proportion than one-third or one-fourth; nevertheless, clays are termed *argillaceous substances*, and those rocks, of which argil forms a notable proportion, are termed *argillaceous rocks*; one character of which is, that they give out a peculiar odour when breathed on, that may always be regarded as a mineralogical test of the presence of argil, whence it has been termed the *argillaceous odour;* but as it does not belong to pure alumine, it is considered to be owing to a combination of that substance with the oxide of iron, which generally enters into the composition of argillaceous minerals.

Alumine, when pure, is perfectly white, and is destitute of taste and smell: its specific gravity is 2.0. It has already been said, in treating of the earths generally, that alumine is not a simple substance, and that Sir H. Davy has ascertained it to be composed of oxygen united with a base, *alumium*, in the proportion of 46 of the former to 54 of the latter; but though the results afford a strong presumption that alumine is a metallic oxide, its base has not been yet obtained in such a state as to render a minute examination of its properties practicable. Yet alloys have been formed, which give sufficient evidence of its existence; and the presence of oxygen in alumine is proved, by its changing potassium into potash, when ignited with that metal.

As the precise nature of its base is unknown, alumine is still ranked among the earths. As an earth, it may be said that it is never found pure. It enters largely into the composition of many earthy minerals, and in small quantity in some metalliferous ores. It is an ingredient, in a large proportion, of some of the most abundant rocks, primitive, secondary, and alluvial, and is found in all soils. It is the most abundant of all the earths, except silex.

It is found in the greatest purity in corundum and its varieties.

Lime.

Lime has never been found pure; when so prepared by the chemist, it is white, moderately hard, of a hot acrid taste, and infusible except by voltaic electricity. Its specific gravity is 2.3.

It is obtained artificially by heating the various species of carbonates, till the carbonic acid is driven off; hence the lime obtained for cements and agricultural purposes. For nice chemical purposes, it is procured in a purer state, by subjecting to a red heat, for some hours, either the white Carrara statuary marble, or oyster shells; the outer coat of the latter being first taken off. From the former, lime is obtained which is mixed only with small portions of silex, and sometimes with an atom of iron; the lime procured from the latter, contains only a little phosphate of lime. These impurities are afterwards got rid of, by chemical processes.

It is not a simple or elementary body; but a compound, consisting of oxygen united with a base which possesses the colour and lustre of silver, but which Sir H. Davy has not hitherto been able to examine; for, on exposure to air and heat, it instantly takes fire, and burns, with an intense white light, into lime; he nevertheless considers it to be a metal, and has denominated it *calcium*. Berzelius estimates lime to consist of 28 per cent. of oxygen, and 72 per cent. of calcium.

Lime enters into the composition of a considerable number of earthy or stony minerals, but is not found in any earthy compound in the proportion of 30 per cent. except when mineralized by an acid; thus combined, it is found in so great abundance, that some geologists have estimated that it enters into the composition of the crust of the globe, in the proportion of one-eighth of the whole.

Lime, and its natural compounds, generally speaking, are of infinite importance and utility; in which respects they are inferior to no other mineral substances, but may, on the contrary, be estimated as superior to all.

It is found mineralized by the carbonic, phosphoric, fluoric, sulphuric, nitric, boracic, and arsenic acids; forming carbonate, phosphate, fluate, sulphate, nitrate, borate, and arseniate of lime; these compounds, in common with all other natural combinations of earths with acids, are, by some mineralogists, termed *earthy salts*.

Magnesia.

Magnesia is a light earth of a perfect whiteness, and is absolutely insipid. It consists of oxygen united with a base *magnesium*, which is but imperfectly known, but which is considered to be a metal, and is of the same whiteness and lustre as the bases of some of the other earths. Berzelius states magnesia to consist of about 38 per cent. of oxygen, and 62 of magnesium.

Magnesia is not, like silex and alumine, found in very large quantity, either nearly pure, or entering in very great proportion, into the composition of numerous and abundant earthy substances: it is found in about thirty, in different proportions; but in most of these, magnesia is not the prevailing ingredient, though in several it exceeds 25 per cent. It is involved in a few metalliferous minerals in small quantity. It occurs combined with the carbonic, sulphuric, and boracic acids; but is found in the greatest purity in the carbonate of magnesia.

Zircon.

Zircon, when pure, is white, rough to the touch, insipid, and insoluble in water; and is about four times its weight. Like the other earths, it is [illegible] by the action of chemical agents; but by the [illegible] it has been ascertained that [illegible] of oxygen united with a base [illegible] known. The proportions in which oxygen and zirconium enter into the composition of zircon, have not been determined: but the existence of oxygen in this earth has been proved by placing potassium in contact with it when ignited; by which means the oxygen of the zircon united with the potassium, forming potash, and dark metallic particles were diffused through the alkali.

It is very sparingly found; and then only entering into the composition of a few substances, together with silex and oxide of iron; and in one instance with a small portion of oxide of titanium. Zircon has not been put to any use.

Glucine.

Glucine obtained that name from the Greek γλυκος, signifying *sweet*, on account of the sweet taste by which its salts are distinguished. When pure, glucine is a white powder, soft, and somewhat unctuous to the touch; its specific gravity is nearly 3.

Sir H. Davy has proved that glucine consists of oxygen united with a base, *glucinum*, of which the nature is not known. It is computed that this earth is constituted of about 30 per cent. of oxygen united with 70 per cent. of glucinum. The existence of oxygen in glucine was proved in the same manner as its existence in zircon.

Glucine has only been met with combined with other substances, and then only in small quantities, and in a very few minerals, viz. euclase, beryl, emerald, gadolinite, and topazolite.

Yttria.

Yttria, in many of its properties and appearances in its pure state, bears considerable affinity to glucine; its salts have the same saccharine taste; but it is easily distinguished from glucine, inasmuch as it is nearly five times heavier than water, and by some properties discoverable only by the chemist.

It has been ascertained by Sir H. Davy that oxygen enters into the composition of yttria: but the base, *yttrium*, with which it is combined, has not yet been seen in a separate form; nor have the proportions in which oxygen and yttrium respectively enter into the composition of yttria, hitherto been decided. The existence of oxygen in it was established by the same process as that of zircon.

In the natural state, yttria occurs as a component part of a rare mineral substance called the gadolinite, which is brought only from Sweden, and which is so called on account of its having been first analyzed by the Swedish professor Gadolin, who named the earth yttria, because the mineral in which it was discovered, was brought from Ytterby in Sweden.

Yttria is also found entering into the composition of a mineral called yttrocolumbite; and in some newly discovered substances in the state of a fluate.

Barytes.

Barytes, when pure, is white, has a sharp caustic taste, and as it possesses some of the characters of the alkalies, it has by some chemists been classed amongst them; others have denominated it an alkaline earth.

Barytes consists of oxygen combined with a base, *barium*, with which it is united in the proportion of about 10 per cent. of oxygen to 90 per cent. of barium. This base has the appearance of a dark grey metal, which requires considerable force to flatten it, and has a lustre inferior to that of cast iron. At the ordinary temperature of the air, it was solid, but became fluid at a heat below redness.

By exposure to the air, this substance became tarnished, and fell into a white powder, which was barytes. A portion of it thrown into water, acted upon it with great violence, and sunk to the bottom, producing barytes, and evolving hydrogen gas; but it has not been obtained in quantity sufficient to allow of a minute examination of its physical or chemical qualities.

Barytes has never been found pure: it is combined either with the carbonic acid, or the sulphuric acid, forming compounds which may be readily distinguished from most other earthy minerals by their superior weight; being more than four times the weight of water.

Barytes is by no means plentifully distributed, since it has not hitherto been detected entering into the composition of any rock; nor in more than one or two earthy minerals; it is not common in soils.

It is a violent and certain poison.

Strontian.

This, like the rest of the earths, when dried and pure, is perfectly white, and resembles barytes in many of its properties.

It consists of 16 per cent. of oxygen, united with about 84 per cent. of a base to which the name of *strontium* has been given by Sir H. Davy; by whom it was first obtained in 1808, but in very minute quantity. It resembled barium, had not a very high lustre, was difficultly fusible, and not volatile; and was converted into strontian by exposure to air, or by contact with water.

Thorina.

This earth, when dried, is perfectly white. Before the blowpipe it cannot be brought into fusion: with borax or phosphate of soda, it fuses into a transparent glass.

In some of its properties it differs from all the other earths; but has not yet been subjected to the action of voltaic electricity.

It was not long since discovered by Berzelius in the gadolinite from Korarvet in the proportion of 30 per cent.; but is not always found as an ingredient of that mineral. It has since been detected in the deuto-fluate of cerium, and in the double fluate of cerium and yttria.

Of the Relative Proportions of the Earths as Mineral Elements.

Silex is not only the chief ingredient of a large number of the most abundant rocks, but also of all clays and soils; and of more than half those compound earthy substances, which, in contradistinction to aggregated rocks, are termed simple minerals; it enters into the composition of a few rare and crystallized metalliferous minerals in the proportion of 30 or 40 per cent., and in very small proportion in several of the most abundant ores of iron. If therefore, it were possible, as heretofore, to regard silex as a simple elementary body, we should have no difficulty in adjudging it to be the most abundant in nature.

Alumine is considered to be the most plentiful earth after silex. It occurs largely in primitive rocks, and in many of the secondary, and in all clays and soils: it enters into the composition of a considerable number of earthy minerals, and in small proportion in a few metalliferous minerals, particularly in certain ores of iron.

Lime is less abundant than alumine in primitive rocks; but is extremely so in transition and flœtz, or secondary rocks; it enters into the composition of many compound earthy minerals: it forms from 9 to 25 per cent. in a few rare crystallized minerals, and is found in smaller proportion in a few others.

Magnesia is not an abundant ingredient in rocks; but is chiefly confined to those called serpentine, basalt, and certain varieties of limestone. Some of the earthy minerals in which it is found, and which are about thirty in number, are principally met with in veins. It occurs but sparingly in soils.

Zircon, *glucine*, *yttria* and *thorina* are sparingly found: the first is the least rare; the others have been found only as ingredients in a few rare minerals.

Barytes is not very abundant; *Strontian* may be esteemed a rare earth; they are chiefly found in mineral veins, and have not been detected in rocks or soils: they are almost always met with combined with acids. Only the former has been found combined in a metalliferous mineral, compact manganese, in the proportion of 14 per cent.

Silex, alumine and magnesia are met with nearly pure, Silex, zircon, glucine and yttria have not been found combined with an acid; but the first is involved in many acidiferous minerals.

Lime, barytes and strontian chiefly occur combined with acids; but the former is an ingredient in many earthy minerals which are not acidiferous.

Thorina has been found only in a very few rare minerals.

THE AKLALIES.

The *Alkalies*, potash, soda, lithia, and ammonia, have peculiar chemical properties, which are not our present object. The three first, not being volatilized by a moderate heat, are termed fixed alkalies; the last is gaseous, and is called the Volatile Alkali. Potash and soda were long considered to be simple elementary bodies, though it was also conjectured that they were not. Within the last few years that conjecture has been verified by the brilliant discoveries of Sir H. Davy, who effected their decomposition by means of electric or galvanic agency. It has by this means been satisfactorily determined that potash consists of oxygen united with a base which, in many, if not in most respects, bears a strong affinity to the metals: it is of a silvery whiteness, and is solid at common temperatures. Soda, it has been determined, consists of oxygen united with a base which is solid at the usual temperature of the air. Lithia has also by the same eminent chemist, been found to be a compound of oxygen and a peculiar base.

These bases, *potassium*, *sodium* and *lithium*, are combustible bodies: by exposure to oxygen, they absorb it, and thus become alkalies again. In lustre, opacity, and malleability, and in certain chemical properties, the two former agree with the metals: and have therefore been considered as metals by Sir H. Davy: but they are lighter than water, and are therefore at least six times lighter than the lightest of the metals, tellurium.

Potash.

It has already been remarked, in noticing the alkalies generally, that potash is not a simple body; that it consists of oxygen united with a base *(potassium)*, which bears a strong affinity, in certain respects, to the metals; and that it much resembles quicksilver, but is lighter than water.

Potash is constituted of about 83 per cent. of potassium, united with about 17 per cent. of oxygen.

It is found in the mineral kingdom, entering into combination in about 20 earthy compounds; amongst which are felspar and mica, two principal ingredients of the oldest of the primitive rocks; it likewise occurs in a few others combined with soda; therefore the term vegetable alkali, as applied to potash, is not correct, although it is procured in the greatest abundance from the combustion of vegetable matter of various kinds.

Potash is likewise found combined with the carbonic and nitric acids.

Soda.

Soda is not a simple, elementary body, but a compound, consisting of a metallic base united with oxygen; the base possesses several characters common to the metals; it most resembles silver in appearance, but is lighter than water. Soda consists of about 75 of sodium and 25 of oxygen.

Soda is no where found in the pure state; it enters into combination in about 15 earthy minerals, in proportions varying from 1 to 35 per cent.; and is met with in a few others combined with potash.

Soda is found both in the mineral and vegetable kingdoms; it occurs combined with the carbonic, sulphuric, boracic, and muriatic acids; forming carbonate, sulphate, borate, and muriate of soda.

Lithia.

This late discovered alkali, like the other two fixed alkalies, from which it differs in some of its chemical characters, is not a simple elementary body, but a compound, consisting of a metallic base lithium, in the proportion of 56.50 to 43.50 of oxygen, by direct experiment.

Lithia has an acrid, caustic taste, and is very soluble in water.

Lithium, the metallic base, was procured by the decomposition of lithia, but the metallic base burned again so rapidly, and by the absorption of oxygen from the air, was so soon reconverted into lithia, that it was only observed to be of a white colour and very similar to sodium.

Lithia was discovered by Arfwedson, a pupil of Berzelius, in the petalite, and since in spodumene, and in a crystallized specimen of lepidolite, but it has not been found in either of these minerals in greater proportion than 8 per cent.

It received the name of lithia from its having been discovered in a stony mineral.

Ammonia.

Ammonia, or *Volatile Alkali*, when pure, is in a gaseous form. It consists of hydrogen and nitrogen: 100 parts contain about 1.76 of hydrogen and 98.24 of nitrogen.

It is only found combined with the sulphuric and muriatic acids; forming sulphate and muriate of ammonia.

Of the Alkalies as Mineral Constituents.

Potash is found entering into the composition of about 15 earthy compounds, but not in any of the metalliferous ores: in small proportions it occurs in mica and felspar, two ingredients of the oldest rocks, and also combined with certain acids.

Soda is found in combination in about fifteen earthy substances in variable proportion; but not in metalliferous ores: it occurs abundantly, combined with several of the acids.

Lithia has been discovered in two or three rare minerals.

Ammonia is met with only in combination with two or three of the acids.

METALS.

A metal may be described as *a shining opaque body, a good conductor of heat and electricity, insoluble in water; capable, when in a state of oxide, of uniting with acids, and of forming with them metallic salts.* This is a character applicable to all the metals and to no other class of bodies.

Metals are believed to be simple substances; not one of them having hitherto been decomposed.

In weight the metals far exceed the earths; the heaviest of the earths is only about five times heavier than water, but the lightest of the metals is more than six times heavier than water. Beaten gold is nineteen times heavier, and beaten platina, the heaviest of all, is twenty-three times heavier than water.

The metals also have other characters. Some of them are exceedingly ductile, as is manifested by the extremely fine wires into which they are drawn. They mostly possess elasticity and flexibility. Some of them have a peculiar taste and smell, both of which are disagreeable.

If when in a state of fusion, they are left to cool slowly and quietly, all the metals crystallize; and most of them in that case assume the form of the octohedron; which also is the form assumed by most of those which are found crystallized in the pure or native state.

The characters of fusibility and extensibility in metals is of vast importance to man; for without them neither could they be freed from the earths and other impurities with which they are naturally united, nor wrought into vessels for his use.

The only metals known to the ancients, were gold, silver, copper, iron, tin, lead, and mercury; but discoveries have from time to time increased the catalogue, until it has been swelled to the number of thirty, independently of those which have very lately been discovered as the bases of some of the earths and the two alkalies.

Of these 28 metals, 12 only have the important property of being sufficiently tenacious to bear extension by beating with the hammer; the others have by some been therefore termed brittle metals.

Malleable Metals.	*Brittle Metals.*
Platina	*Arsenic*
Gold	*Antimony*
Silver	*Bismuth*
Mercury	*Cobalt*
Lead	*Manganese*
Copper	*Tellurium*
Tin	*Titanium*
Iron	*Columbium*
Zinc	*Molybdena*
Palladium	*Tungsten*
Nickel	*Chrome*
Cadmium	*Osmium*
	Iridium
	Rhodium
	Uranium
	Cerium

A lustre is peculiar to the metals, which therefore is called the metallic lustre: another remarkable property is their want of transparency when in the mass; but as leaf gold held between the eye and a luminous body transmits a green light, and silver a white light, it seems probable that other metals, if attenuated in the same degree, would also be translucent.

The only metals that as yet have been found in the metallic state, are platina, gold, silver, quicksilver, copper, antimony, palladium, arsenic, tellurium, bismuth, nickel, and iron; these are then termed *native metals*. But the greater part of these are rarely found quite pure, but mostly contain small proportions of other metals.

A *metalliferous ore* is a compound of two or more metals, as in silver amalgam; or of a *metal in combination with oxygen*, as ruby copper, (whence such a combination has obtained the name of a *metallic oxide*;) or a metal (in the state of an oxide) combined with an *acid*, as in the arseniate of copper; or a metal combined with a *combustible*, as in sulphuretted silver. Many ores are of so compound a nature as to consist of two or three metals united with oxygen, sulphur, one or more of the earths, and with water.

When a metal is combined with one or more substances, either combustible or saline, it is then said to be *mineralized*. Thus lead is said to be mineralized by sulphur when combined with it in the native sulphuret, or galena. The sulphur is the *mineralizer*.

It deserves notice that seven of the *malleable* metals, zinc, tin, lead, iron, copper, nickel, and quicksilver, absorb oxygen from the common air, especially when moist, becoming at least externally oxidated: none of them part with the oxygen by simple exposure to heat, except quicksilver. Gold, silver and platina only become oxidated by exposure to the action of certain acids. But although the greater part of the malleable metals are readily oxidable, not one of them has yet been found in, or converted into, the state of an acid.

All the brittle metals absorb oxygen by exposure to common air, and thus become, at least externally, oxidated. Five of them, arsenic, chrome, molybdena, tungsten and columbium, by an excess of oxidation, pass into the state of acids, and in this state they are found to be the *mineralizers* of some of the earths and of the metals.

The metals and metalliferous ores are chiefly found in veins, of which they occasionally compose the only substance; but they are more often disseminated in veins, through earthy or stony substances: such a substance is termed the *gangue* or *matrix* of the mineral. Metalliferous ores are less commonly found in masses or in beds: a few of them occasionally occur imbedded in certain rocks.

They are met with in veins traversing almost every kind of rock, but are more common in primitive and transition rocks, than in flœtz rocks: they occur but sparingly in alluvial deposits, and more rarely in volcanic matter.

Of the comparative ages of the Metals.

The comparative age of the metals is chiefly judged of by the nature of the rocks which enclose them. Iron and manganese have been detected by most analyses in mica, a constituent of the oldest primitive rock, granite; tin and molybdena occasionally occur imbedded in it; they also, as well as tungsten, titanium, cerium, uranium, chrome, and bismuth, are found almost exclusively in such veins as traverse the oldest of the primitive rocks: the foregoing metals may therefore be considered of the earliest formation. Arsenic, cobalt, silver, nickel, and copper, are presumed to be less ancient, because though they occur in the oldest primitive rocks, they are also found in newer. Gold, tellurium, and antimony, are considered to be the metals of a middle age, as they occur in the newer primitive and the older secondary rocks. Lead, zinc, and mercury, are found in the greatest quantity in secondary formations, and are therefore supposed to be less ancient than the preceding. Platina, palladium, rhodium, iridium, and osmium, never having been found *in situ*, it is impossible properly to judge of their relative age; but as crude platina involves small portions of palladium, rhodium, iridium, and osmium, as well as of copper, gold, and lead, we may conceive them to be of a middle age, and shall therefore in the following series, place them next to gold: cadmium has been found only in certain ores of zinc.

In respect of age, therefore, the metals may be ranked as follows, and we shall accordingly begin the description of metalliferous ores with the important ores of iron:

Iron
Manganese
Molybdena
Tin
Tungsten
Titanium
Cerium
Uranium
Columbium
Chrome
Bismuth
Arsenic
Cobalt
Nickel
Silver
Copper
Gold
Platina
Rhodium
Osmium
Iridium
Palladium
Tellurium
Antimony
Lead
Zinc
Quicksilver
Cadmium

Iron.

Pure Iron is of a bluish grey colour, and has a granular texture; it is hard and malleable, is the most tenacious metal next to gold and platina, and is more ductile than either gold or silver, for it may be drawn out into wire as fine as the human hair; so great is its tenacity, that a wire less than one-tenth of an inch in diameter will bear the weight of 550 lbs. without breaking. When exposed to the atmosphere it absorbs oxygen, or in common language, rusts. Like cobalt and nickel, it is magnetic; and so readily is polarity acquired by iron, that a bar remaining a long time in a vertical position, or even approaching to it, becomes magnetic. The northern pole is always at the lower extremity. The specific gravity of iron is about 7.6—7.8.

Iron is an ingredient of mica, which enters largely into the composition of some of the oldest and most abundant primitive rocks; and being found in all soils, and in almost every rock, it is therefore considered to be the most generally diffused substance in nature. It has been met with in the nearly pure metallic state in considerable masses, reputed to have fallen from the atmosphere; but these masses are generally alloyed by nickel. Native Iron is also said to have been found disseminated in certain metalliferous veins. The ores of iron are very numerous; it occurs combined with sulphur, oxygen, the oxides of titanium, manganese, and chrome; the phosphoric, sulphuric, carbonic, muriatic and arsenic acids; with silex, alumine, lime, and with water. Mineralogists are not well agreed either in respect of the names or the arrangement of the ores of Iron.

The ores of Iron which are of a dark brown or black colour, and in which the iron is combined with a small proportion of oxygen, such as the oxydulated and brown iron ores, belong chiefly, though not exclusively, to primitive countries: they often form an integral part of primitive rocks.

The Red Iron ores chiefly belong to secondary and alluvial countries; they are occasionally met with in the veins of primitive mountains, but are not found entering into the composition of primitive rocks.

The red and argillaceous varieties, but particularly the latter, it is remarkable, are generally found in the neighbourhood of coal, so essential to their reduction to the metallic state; either resting on the coal or lying in slate-clay between the beds in it. Iron ore is thus found in the collieries of Glamorganshire, Monmouthshire, Staffordshire, Shropshire, Yorkshire, and of those of Carron in Scotland.

It would be vain to attempt the enumeration of the uses to which iron is put by man. Steel is an artificial combination of iron with carbon. The brown colour used in porcelain painting is oxide of iron.

An ore, in which iron is combined with alumine, is used in the making of what are termed *red lead* pencils. Plumbago, or *black lead*, is a natural compound of carbon, with a little iron.

Manganese.

Manganese is so difficult to be obtained in the metallic state, that very little more is known of it than that it is of a whitish or iron grey colour, somewhat malleable, brittle, not readily fusible, and that its specific gravity is about 8. When exposed to the air, it soon crumbles into a blackish brown powder, in consequence of the absorption of oxygen, and becomes in succession grey, violet, brown, and finally black.

From the black oxide of manganese, most of the oxygen gas used by the chemist is obtained; it is also employed in the preparation of the oxy-muriate or chloride of lime, consumed in the bleacheries of Britain, France, and Germany. The violet colour employed in porcelain painting is obtained from manganese. In glass-making, it is employed in the finer kinds of glass, both as a colouring material and a destroyer of colour: this applicacation of it is ancient, being mentioned by Pliny.

Manganese belongs perhaps rather more to primitive than to secondary countries. In the state of an oxide it is found combined in a very considerable number both of earthy and metalliferous minerals, though for the most part, only in very small proportion. It may be said to be found almost universally: it is met with both in the animal and vegetable kingdoms, and is an ingredient of mica, which is a constituent of the oldest of the primitive rocks.

Molybdena.

Molybdena is a rare metal, which has never been found pure: it is with difficulty reduced to a pure state, and has only been obtained in brittle infusible grains which are internally of a greyish white. Its specific gravity is 8.6. It is found combined in the metallic state with sulphur; and in the acid state, combined with oxide of lead, forming a mineral called Molybdate of Lead, described under that head.

Tin.

In its pure state, the specific gravity of Tin is about 7.1: but it has never been found pure. It is of a whitish colour, approaching that of silver; and is harder, more ductile, and more tenacious than lead, and may be beaten into leaves $\frac{1}{1000}$ of an inch thick; it is very fusible, and gives out a peculiar crackling noise while bending, but is scarcely, if at all, elastic. It is the lightest of the ductile metals.

Tin was for a considerable time supposed to have been met with in the native or pure state; but it has been pretty well ascertained that the specimens which gave rise to the opinion, were found on the sites of old smelting works, whence these specimens have since obtained the name of ***Jew's-House Tin.*** In the natural state, Tin is found as a nearly pure oxide, or combined, in that state, with small portions of oxide of iron and silex; it generally occurs crystallized, rarely in mass; sometimes in detached rounded pieces from the size of a grain of sand to that of a man's fist. It is also found in combination with copper, sulphur, and iron. Tin belongs exclusively to primitive countries.

The alloys of tin with other metals are mentioned in treating of lead, copper, and quicksilver. Another will be noticed under the article bismuth. In a fine leaf, as tin foil, it is used for many purposes; its salts are used in dyeing: its economical purposes are well known.

Tungsten.

Tungsten, called *Scheelin* by the French chemists and mineralogists, in honor of its discoverer, Scheele, is a hard, brittle, granular metal, of a light steel-grey colour and brilliant metallic lustre. Its sp. gr. is 17.22. It is not found in the pure state; but only in the state of an acid, combined with lime, forming a mineral, commonly called Tungstate of Lime or Tungsten; or with iron, in the mineral called Tungstate of Iron or Wolfram. Tungstic acid consists of 80 tungsten and 20 oxygen.

The ores of tungsten are chiefly, if not exclusively, found in primitive countries.

Titanium.

Titanium is of a copper red colour, and so difficult of fusion, that the attempts to reduce it to a pure metallic state have scarcely succeeded. It has, however, been recognized by Dr. Wollaston in small and brilliant cubes, in the slag of the Iron works of Merthyr Tydvil. An angle of one of them scratched steel, polished agate and rock crystal: they yield to mechanical division parallel to the planes of the cube.

Two of its ores are nearly pure oxides; in the others, Titanium, in the state of an oxide, is in combination with other metallic oxides, or with lime and silex.

The only use to which titanium has ever been put, was in the porcelain manufactory at Sevres, where it was employed to produce the rich browns in painting it. The want of uniformity in colour occasioned its disuse.

Cerium.

Cerium, in its metallic state is scarcely known; Vauquelin succeeded in procuring, by the reduction of one of its ores, a metallic globule, not larger than a pin's head. It was harder, whiter, much more brittle, and more scaly in its fracture, than pure cast iron.

Cerium has hitherto been found entering into combination in a few rare minerals, the other ingredients of which are principally earthy substances. The cerite and the allanite differ considerably in their composition; in both the cerium is in the state of an oxide: in the yttrocerite and in some other rare minerals, in that of a fluate.

Uranium.

Uranium is a brittle, granular, hard metal, of extremely difficult fusibility, and of a reddish-brown colour. It has only been obtained in small grains of considerable lustre. This metal has never been found in any state having a metallic appearance; consequently never in the pure state. It is one of the lightest of the metals; its specific gravity being very little more than 6.

Its ores are only two in number: it occurs in the state of an oxide, and in that of a phosphate: they are considered to belong to primitive countries. No use has hitherto been made of uranium.

Columbium.

This rare metal was first discovered by Hatchett, in a mineral received from America by Sir Hans Sloane, and deposited in the British Museum. This metal was named by the discoverer *Columbium*.

Sometime afterwards Ekeberg a Swedish chemist, discovered in a mineral from Finland, a new metal which he called *Tantalium*.

Specimens of the minerals from America and Finland were afterwards analysed by Dr. Wollaston, who proved the identity of columbium and tantalium: it is therefore manifest that the name given to the metal by the original discoverer claims the preference, and ought to be generally adopted.

This metal, of which the specific gravity is about 6, has lately been reduced to the metallic state by Berzelius; but the mass was merely deprived of its oxygen, it was not melted. It consists in the metallic state of particles adhering so firmly together that water would not pass through them. These particles were hard enough to scratch glass, and were of a dark grey, and when scratched with a knife, or rubbed against a fine grindstone, they assumed a metallic lustre, and put on the appearance of iron; by trituration it may be reduced to a dark brown powder.

It is only found in the state of an oxide, or acid, combined with other substances; its ores are only two.

Chrome.

Chrome is a metal of a greyish white colour, and extremely brittle; its specific gravity is 5.9.: it has never been found in the metallic form, either pure, or combined with any other substance, but only in the acid state, or in that of an oxide.

The chromic acid enters into the composition of the spinelle ruby; with the oxide of lead it is also found combined, forming the chromate of lead; with iron, in the chromate of iron.

Oxide of Chrome is found sparingly. Chrome is the colouring matter of the emerald, and occurs in two or three other earthy minerals; it has likewise been detected in some of the meteoric stones, or aerolites.

Chrome, as obtained in the metallic state by the chemist, from either of the foregoing compounds, has not been applied to any important use: it tinges glass of a green colour. Oxide of chrome has been employed to give a green colour to porcelain, and chromate of lead, prepared artificially, is employed as a pigment.

Bismuth.

Bismuth is of a reddish-white colour, very brittle and easily fusible. Its specific gravity is 9.8.

It is found in the pure or native state somewhat alloyed by arsenic.

The ores of bismuth are few; in one of them it is combined with sulphur; in another with inferior portions of other metals, and with sulphur. It is also met with combined with oxygen. All its ores are considered to belong exclusively to primitive countries.

Bismuth is very little used, but it enters into the composition of some of the soft solders, and of sympathetic ink. It forms alloys with other metals. Tin and bismuth are two of the most fusible metals. The fusible metal of Sir Isaac Newton, is composed of 8 parts of bismuth, 5 of lead, and 3 of tin; when this is thrown into water and heat applied, it melts a little before the water has reached the boiling point.

Arsenic.

Arsenic, when pure, is of a bluish white colour and metallic brilliancy, not unlike polished steel; but, by exposure to air, becomes at length almost black. Its specific gravity is 8.31. It is extremely brittle, and has a granular fracture.

Arsenic is a metal of very frequent occurrence: it is found nearly pure, when it is called Native Arsenic, and in combination with most other metals: its presence, when in considerable quantity, may be detected by exposing the substance to heat, or by striking it with a hammer, which cause the arsenic to give out an odour like that of garlic. It is also found in combination with oxygen; with sulphur; and in the state of an acid, with some of the metals, and also with lime.

Arsenic belongs chiefly to primitive countries.

Cobalt.

Cobalt is of a grey colour, with a tinge of red, and has the magnetic properties of iron: it is very difficult of fusion, brittle, and easily reduced to powder: its specific gravity is 7.7.

It has never been found in the pure, or native state; but is mostly combined with arsenic and sulphur; sometimes mineralized by the sulphuric acid, &c.

The ores of cobalt occur in veins both in primitive and in secondary mountains: mostly accompanied by some of the numerous ores of copper, sometimes by native bismuth, native silver, native arsenic, and the ores of silver.

In Cornwall, cobalt occasionally occurs in the east and west copper veins; sometimes in those of a contrary direction. In one of the latter description, it is found in a mine called Huel Sparnon, near Redruth, (which is situated in argillaceous schistus) with bismuth, nickel, arsenic and sulphur: a block, principally consisting of these substances, which weighed 1333 lbs. was raised from that mine.

Cobalt is much employed in the arts. It is brought to this country reduced to the state of an oxide, of an intense blue colour, called *zaffre*, which when melted with 3 parts of sand and 1 of potash, forms a blue glass, and when pounded very fine is called *smalts*, and is then employed to give a blue tint to writing papers, and in the preparation of cloths, laces, linens, muslins, &c.; for colouring glass, and for painting blues on porcelain. So intense is the blue afforded by zaffre, that one grain will give a full blue to 240 grains of glass.

Nickel.

Nickel is of a colour between tin and silver-white; it is tractable by the magnet, though in a degree considerably l than iron; it is ductile, and nearly as malleable as silver, tal a fine polish, but is not easily fusible: its specific gravity is abou It has not been found quite pure, and its ores are only two number.

It is remarkable that nickel, which is one of the least ab dant metals, has been found by analysis to enter into the co position of meteoric iron, and of all those stony substances wh in various parts of Europe and America, have fallen from atmosphere; whence they are termed meteoric stones.

The uses of nickel are not numerous; it is chiefly emplo in alloys with other metals.

Silver.

Silver, when pure, is soft, opaque, and flexible; a wire o tenth of an inch in diameter will support two hundred seventy pounds without breaking. Its specific gravity is ab 10. It is very white, shining and malleable, and is found in pure or native state; its ores are numerous. It occurs combi with antimony, iron, arsenic, lead, copper and bismuth; mineralized by sulphur, and by the carbonic and sulph acids, and by chlorine.

The ores of silver, whatever may be their composition, principally met with in primitive rocks, but not of the old formation; they are also found in veins in secondary rocks, never in alluvial deposites. Silver therefore is not regarde being one of the most ancient metals.

The mines of Peru and Mexico furnish annually ten ti more silver than all the mines of Europe united.

According to Helms, the mine of Jauricocha, in Peru, wh is about three miles above the sea, contains a prodigious mas porous brown iron-stone, half a mile long, as much broad, about one hundred feet in depth, which is throughout intersper with pure silver; and contains a white argillaceous vein, wh is very much richer. It is asserted that Jauricocha and the mi of the district surrounding it, have yielded forty millions of dol in a year.

The uses of silver are numerous, and for the most part obvi In coin, silver is alloyed by one part of copper to fifteen of sil The yellow colour used in porcelain painting, is oxide of sil

Copper.

Copper, in its pure state, is so tenacious, that a wire one-tenth of an inch in diameter will support two hundred and ninety-nine pounds and a half without breaking: its specific gravity is about 8.

Copper is harder and more elastic than silver, and is the most sonorous of metals: in respect of fusibility it is between gold and iron. It is of a pale red colour, with a tinge of yellow. Its ores are numerous. It occurs in the pure or native state; also combined with iron, antimony, silver and arsenic, mineralized by oxygen, sulphur, and by the carbonic, muriatic, phosphoric, and arsenic acids.

The greater part of the ores of copper seem to belong chiefly, though not exclusively, to primitive countries; and are found both in veins and in beds. Native copper, the red oxide, the sulphuret, yellow copper, grey copper, and the arseniate, and the phosphate, have been found principally in these countries; the locality of the muriate is less known; but the variety of green carbonate, termed malachite, is said to have been met with in every variety of country. The mines of Tunaberg in Sweden, and some others, as well as that of Ecton in Staffordshire, (which yielded the yellow copper ore) are situated in secondary limestone. The mines of Cornwall are situated both in argillaceous schistus and granite.

Veins containing copper are not esteemed to be of so ancient formation as those enclosing tin; because, when these veins meet with each other, those of tin are always traversed by those of copper; but in Cornwall, the ores of both these metals are often found in the same veins, the copper being generally found beneath the tin.

Mines of copper are largely wrought in England, Germany, Sweden, and Siberia; those of Spain, France, Ireland, Norway, and Hungary, are much less extensive and numerous. Copper has been found in Asia, Africa, and America, in considerable abundance.

The uses of copper in all its various states are almost endless, and only, if at all, inferior to those of iron. Alloyed with certain proportions of zinc it forms brass, pinchbeck, tinsel, and Dutch gold, in imitation of gold leaf. With a small proportion of tin, copper forms bronze or bell metal; but if the proportion of tin amount to one-third, it forms speculum metal, used for reflecting telescopes. With zinc and iron it forms tutenag. In porcelain painting, the green is obtained from copper.

Gold.

The specific gravity of Gold, when pure and beaten, is about 19; it is very soft, and perfectly ductile and flexible. So great is its tenacity, that a piece one-tenth of an inch in diameter will hold five hundred pounds without breaking; and it is computed that a single grain of gold will cover the space of fifty-six square inches, when beaten out to its greatest extent; the gold leaf being only $\frac{1}{280000}$th part of an inch in thickness.

Gold is always found in the metallic form, whence by mineralogists it is said to occur in the native or pure state; but it is generally alloyed by small portions of other metals, as silver, copper, &c.

The uses of gold are well known. Alloyed by copper, it is employed for ornamental purposes, coin, and plate.

In English coin it is alloyed by two parts of copper to twenty-two of gold. The alloy of gold used in plate, was formerly the same as the coin: it is now 18 carats or $\frac{18}{24}$ths gold. The purple colour used in porcelain painting is obtained from a preparation of gold.

Platina.

The specific gravity of platina when pure, is about 23; its colour is between tin-white and iron-grey. Its malleability is so considerable, that it may be beaten into leaves as thin as tin foil, and its ductility so great, that Dr. Wollaston has succeeded in drawing it into a wire $\frac{1}{18750}$th part of an inch in diameter, which will support about one grain and one-third of a grain without breaking. It possesses considerable elasticity, and in hardness is not much inferior to iron; but is very difficult of fusion. It is only found in the native state.

Pure platina in thin plates is very ductile and flexible. Of late it has been formed into mirrors for reflecting telescopes, spoons, crucibles, and some vessels of considerable dimension for the use of the chemist in particular processes.

Rhodium.

This metal has hitherto been found only alloying the native platina of Peru. When pure, rhodium has a bright metallic surface, but is not malleable; its specific gravity is about 11.

Iridium. Osmium.

The former of these two metals, when pure, is white, and perfectly infusible by common processes, but has been fused by M. Children's immense galvanic battery, into a metallic globule, which was white, brilliant, and though porous, of the specific gravity of 18.68. The latter is of a dark-grey or blue colour.

They occur, alloying native platina in very small proportion; and likewise together, forming a natural alloy of the two metals, of the specific gravity of 19.5.

Palladium.

The specific gravity of palladium, when pure, is about 11. In colour, it greatly resembles platina, and is malleable and ductile; in thin laminæ it is very flexible, but not very elastic; it is somewhat harder than bar-iron.

It occurs, together with some other metals, alloying, in small proportion, the native platina of Brazil: and also in the native state.

Tellurium.

Tellurium, when pure, is about the colour of tin; it is brittle, and nearly as fusible as lead; its specific gravity is little more than 6.

It is an extremely rare metal, and is found only in the metallic state; but is always alloyed, though in very different proportions, by other metals. Its ores are few and rare.

Antimony.

Antimony is a compact, brittle, silvery-white metal, whose specific gravity is between 6 & 7; it is found nearly pure. In its purified state it is termed regulus of antimony.

The ores of antimony are but few in number; all of which have not been analysed. In some of them it is found combined with oxide of iron, arsenic, silex, sulphur, and oxygen.

Antimony is found both in primitive and secondary countries. It forms alloys with other metals, and is used in the arts. It enters into the composition of printing types; it is also used in medicine.

Lead.

Lead is of a bluish-grey colour, and is malleable, ductile, inelastic, and very soft; it has never been found in the pure or native state: its specific gravity is 11.3.

The ores of lead are numerous; they appear under very different circumstances and aspects, and present a considerable diversity of combination. Lead is found mineralized by sulphur and by oxygen; and in the state of an oxide, by the carbonic, muriatic, phosphoric, arsenic, molybdic, and chromic acids: it is also found in combination with the metals antimony, iron, manganese, and silver, or their ores; with the earths, silex, alumine, lime, and magnesia, and with water. Some of the ores of lead, which are very numerous, present combinations of several of these substances; a few of them have a metallic aspect, but several of them have rather the appearance of earthy minerals, being in considerable degree transparent or translucent. The ores of lead chiefly occur in secondary countries; sometimes in the veins of primitive rocks.

It would scarcely be possible to enumerate all the valuable purposes to which lead is applied to the arts, in medicine, and in the common wants of man. Among its less obvious uses, lead is employed to glaze pottery, and its oxide enters into the composition of glass. With a small proportion of antimony it forms printing types. With tin and bismuth it forms alloys, which are used in the arts.

Zinc,

Zinc is a bluish-grey metal; its tenacity is not great; a piece one-tenth of an inch in diameter will hold twenty-six pounds without breaking; and being far less ductile than some other metals, its importance is thereby diminished. Its specific gravity is about 7.

Zinc is never found in the pure metallic state, but mineralized by sulphur, oxygen, the carbonic or sulphuric acids; and combined with oxide of iron, silex, and with water. Its ores are not numerous, and most of them have the appearance rather of earthy than of metalliferous substances; they belong chiefly to secondary countries.

Zinc is employed by the Chinese for coins: it enters into the composition of many alloys. It is sometimes used in medicine, and in oil painting.

Quicksilver or Mercury.

The liquidity of mercury at the ordinary temperature of the atmosphere, is a remarkable character, and distinguishes it from all other metals. It is thirteen times heavier than water. It is found pure; and also combined with silver, with sulphur, or with small quantities of silex, oxide of copper, carbon and bitumen; and mineralized in the state of an oxide, by sulphuric acid and by chlorine.

Its ores are not numerous; and being rarely found in primitive rocks, it is not considered to be a metal of the newest formation.

The quicksilver mines of Idria, in Saxony, are said to yield 100 tons annually; and those of Spain a still greater quantity. The mines of Peru are by some supposed to be still richer.

The uses of mercury in medicine, in the arts, and in experimental philosophy, are numerous; it is employed in the separation of gold and silver from their ores, by a process called amalgamation. When amalgamated with tin, and laid on glass, it forms mirrors.

Cadmium.

This metal has been obtained by Stromeyer in thin plates; it resembles tin, in colour, lustre, softness, ductility, and in the sound it emits when bent. Its specific gravity is 8.6. It melts, and volatilizes at a temperature a few degrees below that required by tin. It was discovered by Stromeyer in 1817. It was first found in the oxide of zinc prepared for medicinal use, from an ore of zinc found in Silesia; and has since been discovered in some of the ores of zinc found in England.

Of the relative proportions of the Metals.

Iron is an ingredient of almost every rock, from the oldest primitive to the newest alluvial; and also in very many earthy and metalliferous minerals, and in all soils: it is therefore considered to be the most abundant and most generally diffused of all the metals. Wherever found, and with whatever combined, it is mostly in the state of an oxide, except when combined with sulphur.

Manganese is an ingredient of mica, which is a constituent of the oldest granite; its ores occur both in primitive and secondary countries.

Molybdena may be reckoned a rare metal; it is occasionally found imbedded in granite, or in veins passing through it. It occurs only in the state of an acid or an oxide, or mineralized by sulphur.

Tin is abundantly and almost exclusively found in veins passing through primitive rocks, chiefly in granite and argillaceous schistus. Tin is always in the state of an oxide: it occurs only in one or two metalliferous ores.

Tungsten is by no means a plentiful metal, it usually accompanies tin: it occurs only as an acid combined with iron, or with lime, in veins in primitive mountains.

Titanium occurs chiefly in the state of an oxide, and may be reckoned a rare metal: it is usually combined with iron, sometimes with silex.

Cerium is an extremely rare metal.

Uranium is also rare: it occurs mineralized by the phosphoric acid in primitive veins.

Columbium or *Tantalium* is still more rare: it occurs in the state of an oxide or acid; in one of its ores it is combined with iron, in the other with the rare earth yttria.

Chrome is a scarce metal, and occurs in the state of an acid, mineralizing lead and iron: also, though in very small quantities, as an oxide.

Bismuth is not a common metal; it occurs in the native state, also mineralized by sulphur, and combined in some of the ores of silver, and of cobalt.

The preceding metals, being chiefly found in the oldest primitive rocks, are considered to be of the earliest formation; the succeeding five are supposed to be less ancient, because they occur both in the oldest primitive and in certain of the secondary rocks.

Arsenic is a more abundant metal than most of the preceding: it is involved in small portions in several of the native metals, in all the ores of cobalt, and in several of those of silver and of copper.

Cobalt is not found alloying any metal; in its ores it is combined with iron and arsenic; it is not plentiful.

Nickel is a rare metal: it occurs as an oxide, and also combined with arsenic.

Silver is a somewhat abundant metal; and occurs in greater or less quantity in most mineral countries: in the native state, it occurs in veins and beds, and disseminated in rocks: its ores are numerous; it occurs combined with lead, copper, iron, antimony, tellurium, gold, quicksilver, and arsenic, and mineralized by sulphur, and by certain acids.

Copper is an abundant metal; it occurs in the native state: its ores are numerous, and in them copper is combined with iron, sulphur, silex, oxygen, and certain acids: it occurs in most mineral countries.

Most of the following metals are found in the newer primitive and older secondary rocks, and therefore are metals of a middle age.

Gold, though less abundant than silver, is more so than most of the preceding, and is not to be esteemed a rare metal; though occasionally met with in veins, it is chiefly found in rivers and alluvial deposites: it occurs from 1 to 26 per cent. in the ores of tellurium, and sometimes in small portions alloying the native metals, copper, antimony, platina, and arsenic.

Tellurium is a rare metal; it occurs in the native state, but mostly is alloyed by a little gold: in its ores it is combined with gold, silver, lead, copper, and sulphur: it has only been found in two or three places.

Platina is not a plentiful metal: it is chiefly found in certain districts in America, and only in the native state; alloyed by small portions of gold, lead, copper, iron, palladium, osmium, iridium, and rhodium.

Palladium is rare; it is found with platina, in the native state, alloyed by small portions of platina and iridium.

Iridium and *Osmium* are found together forming an alloy, which accompanies platina; they also alloy platina, and the former of them, palladium: they are both rare.

Rhodium is found only alloying the platina of Peru.

Antimony is not a very rare metal: it occurs in the native state, alloyed by small portions of iron and silver: in its ores it is combined with sulphur, silex, and oxygen: it occurs in few mineral districts.

Lead may be considered as the most abundant and most universally diffused metal after iron: it never is found in the native state, but its ores are very numerous: it occurs abundantly mineralized by sulphur, and by certain acids; and is found in the state of an oxide: it occurs in certain ores of tellurium.

Zinc is not a scarce mineral, but is pretty generally diffused: in its ores, it occurs combined with sulphur, iron, and oxygen.

Mercury is found only in a few places, but is not scarce: it occurs native, and combined with silver, sulphur, and with certain acids.

Cadmium, has been found only in a few of certain ores of zinc.

Of the Acids as Mineral Constituents.

The *Acids* which occasionally enter into the composition of minerals are thirteen in number.

It is impossible to give such a description of the acids as will characterize them altogether. The greater part of them are chemically described as possessing a sour taste of various degrees of intensity, and of reddening vegetable blue colours: but these properties are not common to all of them.

The peculiar properties of each acid are derived from the base. This base in most of the acids is united with a certain proportion of oxygen; which until lately was conceived to be the acidifying principle. In two of the acids it has however been proved that no oxygen exists.

The names given to the acids have been mostly derived from their bases: thus sulphur, in combination with a certain proportion of oxygen, affords sulphuric acid; carbon affords carbonic acid, and so on.

100 parts of the

*Acid.**		*Base.*		
Carbonic consist of	73.73	of *carbon* and	27.27	of *oxygen*
phosphoric	42.85	*phosphorus*	57.15	—*oxygen*
fluoric		*fluorine*		—*hydrogen*
sulphuric	40...	*sulphur*	60...	—*oxygen*
muriatic	97. 3	*chlorine*	3	—*hydrogen*
nitric	25.92	*nitrogen*	74.08	—*oxygen*
boracic		*boron*		—*oxygen*
tungstic	80...	*tungsten*	20...	—*oxygen*
chromic	53.84	*chrome*	46.16	—*oxygen*
molybdic	66.66	*molybdena*	33.34	—*oxygen*
arsenic	61. 3	*arsenic*	38. 7	—*oxygen*
succinic	47.11	*carbon*	52.54 35	—*oxygen* —*hydrogen*
mellitic		*unknown*		

Each of the above acids is found in one or other of the mineral substances about to be described; and in the preceding list they are arranged in the order of their supposed formation, arguing from the nature of the rocks in which the substances mineralized by them are met with.

The carbonic, phosphoric, fluoric, sulphuric, muriatic, nitric, tungstic, boracic, and arsenic acids, are found in combination with earths.

The carbonic, phosphoric, sulphuric, muriatic, tungstic, chromic, molybdic, and arsenic acids, are found mineralizing certain of the metals.

The nitric and carbonic acids are found united with potash.

The carbonic, sulphuric, muriatic, and boracic acids are found combined with soda.

On reviewing the list of Mineral Constituents given at page xlviii, we shall perceive that it includes all the substances of which the forementioned acids are composed, whose composition is known, and we might therefore incline to add to the catalogue of Mineral Constituents, the Mellitic acid, as not having been yet analysed; there is however no doubt that it is a compound.

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* The composition of the acids of which the proportions of the base and acidifying principle are not given, has not yet been ascertained.

Of Water, as an essential Element in certain Minerals.

Water is composed of oxygen and hydrogen, in the proportion of about 88½ of the former to 11¾ of the latter.

Water may be considered as an accidental ingredient and not as an element, of most minerals: it is occasionally enclosed in crystal and chalcedony, and in variable proportion in such minerals as are porous or of a loose texture; but, in some others, it is an essential principle, as is evinced by the difference existing between the forms of the primary crystals of the common, and of the anhydrous, sulphate of lime: the latter of these is composed of lime and sulphuric acid; the former, of lime, sulphuric acid, and 21 per cent. of water: when water is an essential principle, it is termed *water of crystallization.*

Water is found in very different proportions, in a large number of earthy, as well as of metallic, minerals, both crystallized and massive.

The pure alkalies, potash and soda, retain even after fusion, about one-fifth of their weight of water; and all acids, in a liquid state, contain water as an essential element.

Of Combustible Minerals generally.

Combustibles form, in the mineral kingdom, a class of substances, having peculiar properties, and by no means agreeing amongst themselves in internal or external characters, and differing essentially from the earths, the alkalies, and the metals. Combustibles include both the hardest and the softest of mineral substances.

Several of the combustibles are found in a liquid state, some of them are translucent and even transparent; but the greater number are solid; when solid they are easily broken; they possess neither the opacity, brilliancy, nor the weight of metals, being rarely more than twice the weight of water; some of them are lighter than water.

If we were to class among combustibles all those bodies whose chemical characteristic is that they will endure combustion, we should err, because many of the metals have that character.

Most of the metals whose properties are altered by combustion, acquire an increase of weight thereby; whereas combustible substances are sensibly diminished in weight by the same process. The product of some of them is liquid, of others, solid; if solid, it is insoluble in water. Combustibles are either simple or compound.

EXPLANATIONS OF TERMS, &c.

Commonly used in Mineralogical Descriptions.

Acicular. Long, slender, and straight prisms, or crystals, are termed acicular, from the latin, acicula, a little needle.

Acids, see p. lxxxii.

Acute rhomboid. See Rhomboid.

Acute octohedron. See Octohedron.

Aggregated. A mineral or rock is said to be aggregated, when the several component parts only adhere together, and may be separated by mechanical means: the felspar, quartz, and mica, constituting granite, may be separated mechanically. Granite is an aggregated rock.

Alkalies, see p. lxii.

Alliaceous. The odour given out by arsenical minerals, when exposed to the blow-pipe or struck by the hammer, resembles that of garlic, in latin, allium; whence alliaceous.

Alloy. A natural combination of two or more metals in the metallic state.

Amalgam. A natural combination of two metals, of which mercury is one.

Amorphous. Without form; of undefinable shape; from the Greek, *αμορφος* (amorphos) having that signification. Amorphous minerals are sometimes described as being of indeterminate, or indefinite forms.

Anhydrous, from the Greek, *ανυδρος* (anudros), signifying without water: anhydrous gypsum is without water.

Arborescent. From the Latin, arboresco, to grow like a tree: see Dendritic.

Arseniate. A term applied to a mineral consisting of the *arsenic acid* united with a base, as of copper in the arseniate of copper.

Arsenic acid, see p. lxxxii.

Base. A term denoting the substance to which an acid is united; in the arseniate of copper, the copper is the base.

Bevelled, see p. viii.

Boracic acid, see p. lxxxii.

Borate. A mineral in which the boracic acid is combined with a base, as of magnesia, in the borate of magnesia.

Botryodial. From the Greek, βοτρυώδης (botruodes) signifying, hung with clusters of grapes or berries. So a mineral presenting an aggregation of large sections of numerous small globes, is termed botroyidal, but when the globes are larger, and the portions are less, and separate, the appearance is expressed by the term mamillated. These forms may be observed in certain ores of cobalt, copper, and manganese, and often in chalcedony.

Bladed. This term relates chiefly to the structure of such minerals as, on being broken, present long flat portions longitudinally aggregated, and somewhat resembling the blade of a knife; this appearance may in general be considered as the effect of interrupted crystallization.

Brittle. This character of mineral bodies does not depend upon their hardness; those of which the particles cohere in the highest degree, and are immoveable one among another, are the most brittle. The diamond, quartz, sulphate of barytes and sulphur, vary greatly as to hardness; they are all brittle, the first only in particular directions. See p. xxxi.

Canaliculated; presenting deep channels on the surface, resulting either from interrupted crystallization, or the aggregation of numerous crystals.

Capillary, is derived from the Latin, capillus, a hair, and is chiefly used to express the long, tortuous, hair-like appearances, to be observed in native gold, and silver, and some other minerals. Crystals are sometimes termed capillary, when long and slender; but when straight, they are more properly designated by the term acicular.

Carbon, see p. lxxix.

Carbonate. A mineral in which the carbonic acid is combined with a base, as of lime, in the carbonate of lime.

Cavernous. A mineral in which there are considerable hollows or cavities, is said to be cavernous.

Cellular. This term was used by Werner in the description of such minerals as exhibit cells formed by the crossing and intersecting of the laminæ or lamellæ of which they are constituted: commonly, any mineral presenting numerous small cells or cavities, is termed cellular: see vesicular.

Chatoyant, has been adopted from the French, who use it to express the changeable light resembling that to be observed in the eye of a cat, to be seen in certain minerals; as in the Cat's-eye.

Chromate; a mineral in which the chromic acid is united with a base, as of lead, in the chromate of lead.

Chromic acid. see p. lxxxii.

Cleavage. This term is most commonly used in relation to the fracture of those minerals which, having natural joints, possess a regular structure, and may be cleaved into more or less geometrical fragments; as, into varieties of the parallelopiped, the rhomboid, &c. See p. ix. & seq.

Coherent. In minerals that are brittle, the particles are strongly coherent; in such as are friable, they are slightly coherent.

Columnar distinct concretions; a term used to express the great and small columns in which certain basalts and iron ores are found: but Werner included under this term all the columnar appearances in every mineral consisting of numerous aggregated crystals, which readily divide into long and narrow portions of irregular form, owing to interrupted crystallization—such as the amethyst, pyrites, fluor spar, quartz, &c.

Combustibles, see p. lxxxiii.

Combustion. During the burning of a combustible, in common cases, oxygen unites with it, or with some of its ingredients: and the product of the combustion is either an oxide, an acid, or an alkali.

Compact. A mineral is compact when no particular or distinct parts are discernible; a compact mineral cannot be cleaved or divided into regular or parallel portions. The term compact is too often confounded with the term massive.

Concentric lamellar. This may be said to relate to structure, being used in the description of such minerals as, being of a spherical form, or of any portion of a sphere, have received successive coatings or depositions. If an onion be cut in two, it exhibits the concentric lamellar appearance in perfection.

Conchoidal, relates only to fracture; and is doubtless derived from the Latin, conchoides, signifying like the shell of a fish. Fragments of many of the brittle minerals exhibit this appearance, and occasionally in great perfection, as quartz and sulphur: the fracture of compact minerals is frequently more or less perfectly conchoidal.

Concretion, generally signifies a small and distinct mass.

Coralloidal, resembling branches of coral.

Cuneiform, wedge-shaped; cuneus, in Latin, signifies a wedge.

Cuneiform octohedron. See octohedron.

Decomposed. This term, when used strictly in a mineralogical sense, imports the consequence of the chemical action which takes place naturally in some minerals. Certain ores of iron, &c. in which sulphur predominates in an unusual degree, decompose by exposure to air.

Decrement. This term relates to structure, see p. xix.

Decrepitate. A mineral is said to decrepitate on exposure to heat, when it flies with a crackling noise similar to that made by salt when thrown into the fire.

Dendritic; derived from the Greek, δενδριτις (dendritis) signifying, like the growth of a tree. The terms arborescent and dendritic are used synonimously: they are alike applied to the tree-like appearance in which native silver and native copper are sometimes found; to the delineations seen on the surfaces of certain minerals; and to the appearance in the mocha-stone, &c.

Dentiform or *Dentated;* in the shape of teeth; dens being the Latin for a tooth.

Disseminated. When a mineral, whether crystallized or otherwise, is found here and there imbedded in a mass of another substance, it is said to be disseminated in the mass. Crystals of quartz sometimes occur, disseminated in Carrara marble, &c.

Disintegrated. This term is generally used to express the falling to pieces of any mineral, without any perceptible chemical action.

Diverging, or *Divergent.* When the structure is fibrous, and the fibres are not parallel, they usually diverge in part, but not wholly, around a common centre; as in certain zeolites, and hæmatites iron ores. The crystals of some substances assume a diverging position.

Drusy, has been adopted from the German term drusen, for which we have no English word. The surface of a mineral is said to be drusy when composed of very small prominent crystals, nearly equal to each other; it is often seen in iron pyrites.

Efflorescence. An efflorescence is the consequence of chemical action; it is usually applied to such minerals as are found in extremely minute fibres on old walls, &c. &c.

Elastic. A mineral which, after being bent, springs back to its original form, is elastic. Mica is elastic; talc, which greatly resembles mica, is only flexible.

Earthy. This term relates to fracture, and to texture. Chalk and certain of the ores of iron and lead are notable instances of the earthy fracture or texture.

Fasciculated. When a number of minute fibres or acicular crystals occur in small aggregations or bundles, they are said to be fasciculated; a term doubtless derived from the Latin, fasciculus a little bundle. This appearance often occurs in green carbonate and arseniate of copper.

Fibrous. This term relates both to form and structure. Certain minerals, as amianthus, amianthiform arseniate of copper, a variety of gypsum, &c. occur in distinct fibres. Asbestus, gypsum, red hæmatites iron ore, &c. are found massive, and of a parallel fibrous structure: some varieties of red hæmatites and other minerals are of a radiating fibrous structure, when the fibres diverge from a common centre.

Filament. A mineral is said to occur in filaments, when it is found in slender, thread-like or hair-like portions. It is therefore nearly synonimous with the term capillary.

Filiform, is used in the same sense as the preceding; but Werner confined its use to express the appearance of certain metals which occur in the form of wire, as native silver and native copper. Filum in Latin, signifies thread; filum metalli, wire.

Fistuliform. Minerals occurring in round hollow columns, are termed fistuliform; fistula, in the Latin, siguifies a pipe. Stalactites and iron pyrites occur fistuliform.

Flexible. Talc is flexible; it readily bends, but does not return of itself to its original form. Mica is both flexible and elastic.

Fluate. This term designates a mineral in which the fluoric acid is combined with a base, as with lime in the fluate of lime.

Fluoric acid, see p. lxxxii.

Foliated. This term, which doubtless is derived from the Latin foliatus, having, or consisting of leaves, is used by Werner to express the structure of all minerals that may be divided or cleaved regularly, and are therefore by him said to consist of folia or leaves. The structure of such minerals is more commonly and better expressed by the term lamellar; and they are said to consist of laminæ.

Fracture, is a term now chiefly employed in designating the appearance of minerals which have no regular structure, when they are broken: such minerals present an earthy even, uneven, or a conchoidal fracture, &c.

Frangible. The term frangibility has relation to the susceptibility of minerals to separate into fragments by force: this quality in minerals is not dependent on their hardness; the structure of some and the brittleness of others, renders them easily frangible; while others, which from their softness, and the ease with which their particles or molecules yield or slide over one another, are much more difficultly frangible; such minerals possess the character of toughness. Quartz is easily broken, asbestus is tough.

Friable. A mineral whose portions or particles slightly cohere, and which is therefore easily crumbled or broken down, is said to be friable, or in a friable state.

Fungiform. Certain substances, as for instance calcareous stalactites, are occasionally met with having a termination similar to the head of a fungus; whence they are said to be fungiform.

Gangue, Gangart. We have these terms from the Germans; the gangue of a mineral, is the substance, in, or upon which, a mineral is found: it is sometimes termed the matrix. Silver, occurring in, or upon carbonate of lime, is said to have carbonate of lime for its gangue or matrix.

Geode. This also we derive from the Germans. A geode is a hollow ball; at Oberstein in Saxony are found hollow balls of agate lined with crystals of quartz or amethyst, which are termed geodes.

Glance is also a German word, meaning shining; thus, the followers of that school use the terms glance-coal, copper-glance, &c.

Globular distinct concretion is used to designate the form of any mineral which occurs in little round or roundish masses; the pea-stone and roe-stone are examples of it.

Granular. The structure of a mineral is said to be granular, when it appears to consist of small grains or concretions, which sometimes can, sometimes cannot, be discerned without the help of a glass; we have therefore the fine granular, and the coarse granular structure.

Greasy is used in relation to lustre: fat quartz has a greasy lustre.

Hackly. This term relates to a fracture which is peculiar to the malleable metals; which, when fractured, present sharp protruding points.

Hæmatites is derived from the Greek *αιματιτις*, signifying blood-red; it was first applied by mineralogists to the variety of iron ore which now is called the Red Hæmatites; but has since been extended to other iron ores of the same structure, but differing in colour. We have also brown hæmitites, and black hæmatites iron ore.

Hepatic. A term derived from the Latin, hepar, the liver; it is applied either to colour or form. We have hepatic pyrites, hepatic quicksilver; the hepatite.

Hydrate is derived from the Greek ὕδωρ, (udor) water; and is applied to certain of those minerals (as the hydate of magnesia) of which water forms an ingredient in very large proportion.

Hydrogen, see p. li.

Imbedded. A mineral found in a mass of another substance, is said to be imbedded in it. Crystallized quartz occurs imbedded in Carrara marble. It also occurs partly imbedded in other substances, as in fluor.

Indeterminate. Indefinite. These terms are used synonimously with Amorphous in describing minerals which have no particular or definable form. Crystals of which the form cannot be accurately ascertained, are said to be of indeterminate forms.

Incrusting: any substance covered by a mineral, is sometimes said to be incrusted by it: thus the various articles which are placed for a certain length of time in certain springs or wells in Derbyshire, &c. and which are by some supposed to be converted into petrifactions, are only incrusted with calcareous, or argillaceous matter.

Interlacing. Interlaced. When fibres or crystals of a mineral are found intermingling with each other in various directions, they are said to be interlacing or interlaced.

Investing. A mineral coating, or covering another, is sometimes described as investing it.

Iridescent. This term relates only to the colour with which the surfaces of some minerals are naturally tarnished: as yellow copper ore, iron pyrites, galena, sulphuret of antimony, &c.

Irisated. A mineral is described as irisated which exhibits the prismatic colours either externally, or internally; the latter is generally the consequence of some injury sustained by the mineral.

Lamellæ. If a mineral be found in very minute, thin plates, it is said to occur in lamellæ.

Lamellar; this term relates to structure: when a mineral can be fractured or cleaved into regular and parallel plates its structure is said to be lamellar; and the portions thus obtained are termed laminæ or lamellæ; these terms have been adopted from the Latin, in which they were almost synonimously used to express thin plates of any substance.

Lamellar distinct concretions. This term is sometimes used to express the form of certain minerals (as the oxide of uranium) consisting of separate tabular crystals.

Lamelliform. A mineral consisting of lamellæ, is said to be lamelliform.

Laminæ. See *Lamellar.*

Lenticular is employed to express the forms of certain crystals which are nearly flat, and convex above and beneath; and which consequently resemble a common lens.

Malleability. Some of the metals suffer extension when beaten with a hammer; and are therefore termed malleable metals. Native gold and native silver are very malleable metals.

Mamillated. See *Botryoidal.*

Massive. This term is sometimes used in describing a substance of indeterminate form, whatever may be its internal structure; but is more commonly applied to those minerals which possess regular internal structure, without any particular external form.

Matrix. See Gangue.

Meagre. This term relates to the touch or feel of a mineral. It belongs chiefly to some of those minerals which are of an earthy texture. Chalk is remarkably meagre to the touch.

Mechanical division, see p. ix.

Molybdate; a mineral in which the molybdic acid is combined with a base, as with oxide of lead in the molybdate of lead.

Molybdic acid, see p. lxxxii.

Muriate; a mineral in which the muriatic acid is combined with a base, as with soda, in the muriate of soda.

Muriatic acid, see p. lxxxii.

Natural joints. Such minerals as can be broken into regular forms, as the cube, rhomboid, &c. can be cleaved into those forms, only in the direction of, or along, their natural joints. In some minerals, however, the natural joints are perceptible by the assistance of a strong light.

Nacreous relates to lustre; and is employed to express the lustre of some minerals (as of pearl spar) which greatly resembles that of pearl. Nacre de Perle, in French, signifies Mother of Pearl.

Nitrate. A mineral in which the nitric acid is combined with a base, as with potash, in the nitrate of potash.

Nitric acid, see p. lxxxii.

Nitrogen, see p. l.

Nodular. A mineral which presents irregularly globular elevations, is termed Nodular. Flint is found in nodular masses.

Oblique prism, see Prism.

Obtuse octohedron, see Octohedron.

Obtuse rhomboid, see Rhomboid.

Octohedron. Octohedrons are of several kinds. An octohedron is sometimes described as two four-sided pyramids, *base to base*. In the *regular* octohedron, the three sides of each plane are of the same length. In the *obtuse* octohedron, the base is longer than the two sides. In the *acute* octohedron, the base is shorter than the two sides. In some obtuse and acute octohedrons, the base is square, in others, rectangular, but not square. In the *rhomboidal* octohedron, the common base is a rhomb or rhombic; and the three sides of each plane are of different lengths. In the *cuneiform* octohedron, the common base of the pyramids is not square, and the planes are not all equal, but resemble each other two and two, on opposite sides of the pyramid.

Opaque. Those minerals are opaque which do not transmit a perceptible ray of light even through the thinnest and smallest pieces.

Oxide. This term is used mineralogically to designate metallic minerals, in which the metal is combined with any proportion of oxygen, which is less than suffices to convert it into an acid. Iron is found in different states of oxidation. (See p. xxxvii.) Every metal which is found united with an acid, is, when so combined, in the state of an oxide: but when united with sulphur, the metals are not in the state of oxides, but in the metallic state.

Oxygen, see p. xlix.

Parallelipiped, see p. xi.

Pass into. One mineral is said to pass into another, when both are found so blended in the same specimen, that it is impossible to decide where the one terminates, and the other begins. Flint is found passing into chalcedony.

Pectinated. If a mineral exhibit short filaments, crystals, or branches which are nearly parallel and equidistant, it is pectinated: pecten, in Latin, signifies a comb.

Peroxide, see Magnetism.

Porous. A mineral is said to be porous, when it is traversed in different directions with communicating holes which pass through the substance.

Primary crystal, see p. ix.

Protoxide, see Magnetism.

Phosphate. A mineral in which the phosphoric acid is combined with a base, as with lime, in the phosphate of lime.

Phosphoric acid, see p. lxxxii.

Phosphorus, see p. liii.

Prism. Prisms have four or more sides surrounding the *axis*: they are sometimes terminated by a *single plane*, and when this plane is at right angles to the axis, we have a *right prism*; but if the terminating plane be not at right angles to the axis, we have an *oblique prism*. If the sides of a quadrangular prism, are at right angles with each other, we have a *rectangular* prism, and if the sides be of equal width, a *square prism*, and its height is either greater or less than that of the cube.

Pseudomorphous. Minerals exhibiting impressions of the forms peculiar to the crystals of other substances are said to be pseudomorphous. Quartz exhibiting crystals in the form of the cube; calamine, such as are peculiar to carbonate of lime, &c. are termed pseudomorphous: ψευδος, in Greek, signifies false; μορφη, form or figure.

Pulverulent. When the particles of a mineral are very minute and cohere very slightly, or not at all, it is said to be pulverulent; or in the pulverulent state.

Radiated; radiatus, in Latin, signifies beset with rays; when the crystals of a mineral are so disposed as to diverge from a centre, they are said to be radiated.

Ramose; ramus, in Latin, signifies the branch of a tree; a mineral having that appearance is described as being ramose.

Rectangular prism, see Prism.

Refractoriness. The term is used both chemically and mechanically in relation to minerals. It is sometimes applied to those which strongly resist the application of heat; and occasionally to some whose toughness enables them to resist repeated blows.

Reniform. Kidney-shaped; ren, in Latin, signifies kidney.

Replacement, see p. viii. § 10, and xxi. note.

Retiform, *Reticulated*. Minerals occurring in parallel fibres, crossed at right angles by other fibres which also are parallel, exhibit squares, like the meshes of a net. Retis, in Latin, signifies a net. We have reticulated native silver, native copper, red oxide of copper, &c. And it may be remarked that such minerals as occur reticulated, generally assume the cube, as one of their crystalline forms.

Rhomboidal octohedron, see Octohedron.

Right Prism, see Prism.

Rhomboid. Rhomboids are of two kinds; obtuse and acute. In each there are two points that may be termed the apices. The planes of the obtuse rhomboid meet at each apex, under one obtuse and two acute angles: while three planes of the acute rhomboid, meet at the apex under acute angles.

Schistose structure. Minerals which split only in one direction, and present fragments which are parallel, but of unequal thickness, which also are not smooth and even, and are without lustre, are said to possess a schistose structure. Schist in the German signifies slate.

Scopiform. If a number of minute crystals or fibres be closely aggregated into a little bundle, with the appearance of diverging slightly from a common centre, they are said to be scopiform. Scopa in Latin, signifies a broom or besom.

Secondary Crystals, or forms. Such crystals as do not exhibit any portion of the *primary* planes are termed secondary crystals. Thus, in fluor, the cube is a secondary crystal.

Sectile. The term sectile is derived from the Latin, seco, to cut. Those minerals are termed sectile which are midway between the brittle and the malleable. A slice or portion cut from a sectile mineral, is fragile, and the new surface on the mass is smooth and shining. Plumbago and the soapstone are both sectile.

Semi-transparent. A mineral is said to be semi-transparent when an object is not distinctly seen through it.

Slaty structure. This term is synonimous with Schistose structure, which see.

Solid angle, see p. vii.

Specific Gravity, see p. xli.

Specular Minerals are those which present a smooth and brilliant surface which reflects light; those which present only one such surface, which is not crystalline, are commonly termed specular: but among crystallized minerals we have specular iron, from the brilliancy of its planes. Speculum, in Latin, signifies a looking-glass.

Spicular and Splintery Fracture belong to imperfectly crystalline minerals. These fractures do not greatly differ: they are both irregular; the spicular is shorter and more pointed than the splintery.

Square Prism, see *Prism.*

Stalactitiform. σταλάγμα, (stalagma) in the Greek, signifies a drop, an icicle. Stalactitiform minerals greatly resemble icicles in shape.

Stalagmite. A stalagmite is the deposition afforded by the water dropping from a stalactite, as on the floor of a cavern.

Stellated. When the crystals or fibres of a mineral diverge all round a common center, it is said to be stellated: stella, in Latin, signifies a star.

Striæ, Striated. The slight channels occasionally observable on the planes of crystallized minerals are termed striæ, and the crystals on which they are seen are said to be striated. The striæ are commonly parallel, and generally indicate the direction in which crystals may be cleaved. Stria, in Latin, signifies a groove, or channel.

Structure. This term relates to the internal characters of minerals. Such as can be cleaved into regular forms, presenting smooth, brilliant, and parallel surfaces, are said to have a crystalline structure; but when the surfaces are neither smooth nor parallel, and when, on the contrary they are rough and curved, or undulating, the structure is said to be *imperfectly crystalline;* under which term also may be comprehended all fibrous minerals whether massive or not. All such as have no determinate structure, as those minerals which are granular, splintery, &c. may be included under the term indefinite or promiscuous structure. See page viii & seq.

Sulphate. A mineral in which the sulphuric acid is combined with a base, as with lime, in the sulphate of lime.

Sulphur. see p. lxxxi.

Sulphuret. A metallic mineral in which the metal is combined with sulphur. In these minerals the metal is not in the state of an oxide, but in the metallic state.

Sulphuric Acid, see p. lii.

Supernatant. Such minerals as are lighter than water, and consequently swim upon it, are said to be supernatant. Supernato, in Latin, signifies to swim or float upon.

Tabular. When this term is used in relation to structure it is nearly allied to the schistose or slaty. Talc, mica, and roofing slate, are described by the German School, as possessing a tabular structure. This term is used more generally to express the external form of such crystals as are nearly flat: these are termed tabular crystals; from the Latin, tabula, a table board.

Terminal plane, see p. vii.

Toughness relates to internal texture. Those minerals which are bruised, or suffer depression, by repeated blows in the attempt to fracture them, are esteemed to be tough.

Translucent. A mineral through which an object cannot be seen, but which transmits some light, is termed translucent. Rock salt, sometimes quartz, flint, and fluor, &c. are translucent: many minerals are translucent on the edges, as common marble, &c.

Transparent. Those minerals are transparent through which an object may be clearly seen.

Truncated, see p. vii.

Tubercular. A mineral whose unevenness of surface arises from small and somewhat round elevations, is said to be tubercular. Flint is sometimes tubercular.

Tuberous: exhibiting somewhat circular knobs, or elevations.

Tubular, see Fistuliform.

Vesicular. A mineral is said to be vesicular, when it has small and somewhat round cavities, both internally and externally. Lava, pumice, limestone, basalt, &c. are sometimes vesicular: from the Latin, vesicula, a little bladder.

Vitreous; from the Latin vitreus, glassy; minerals having the lustre of glass, are said to possess the vitreous lustre.

Unctuous. The term relates to the touch. Pipe-clay is somewhat unctuous: Fullers' earth is unctuous; plumbago and soap-stone are very unctuous.

OF THE ARRANGEMENT IN WHICH MINERALS

ARE DESCRIBED IN THE FOLLOWING PAGES.

◆

In the absence of that organization which so admirably serves as a guide to the generic differences in animals and plants, we must seek for some other basis on which to found an arrangement of minerals. No one has yet been, nor does it seem possible that one should be constructed, that is altogether satisfactory;—one, in which there is not much that is arbitrary.

The characters of minerals are of two kinds, Physical and Chemical (p. iv); every system must be founded on one or the other of these, or upon their combination.

Of the Physical characters, the most valuable, because the most certain, when it exists, is Structure: and since by it alone we may often recognize a mineral, it is highly deserving of the earliest attention of the student. There are however many minerals in which no regular structure is visible. If therefore we would depend on the physical characters, we must look for some other amongst them: but there is no one other of them which is so invariable as structure. Therefore, any arrangement that is made to depend on the physical characters, can only be founded on a comparison of a number of them:—but many if not most of these characters are subject to some, and often to a considerable degree of variation, even in the same substance.

The physical characters therefore are not of that precise, invariable, and universal application which alone would justify their adoption, as the basis of an arrangement.

One of the chief difficulties attendant on the plan of arranging minerals according to their composition, is, the uncertainty which exists in particular substances, as to what their absolutely *essential constituents* are. It may however be understood, that whatsoever enters into the composition of a mineral, that does *not alter the external form and internal structure* of that substance in its purer state, is not an essential element, but an accidental ingredient;—thus among earthy minerals, the various colouring matters of quartz, and in the rhombic calcareous spar of Fontainbleau, the sand it encloses, which is said to amount to one-fifth of the whole weight of the mineral, are only accidental ingredients;—among metalliferous minerals, grey copper or fahlerz may be cited as an instance of remarkable diversity of composition, without any alteration of external form; for besides copper, iron, and sulphur, it sometimes includes a proportion of arsenic, or lead, or silver, or antimony. Many other instances might be cited.

Another difficulty arises from the still progressive state of chemistry. Hence, new analyses, whenever they offer new results, tend to a perplexity of choice, which can only be terminated by selecting that analysis which has resulted from the labours of the most eminent analyst.

But although these difficulties are attendant upon a reliance on the chemical characters as the basis of an arrangement; such an arrangement appears to be equally certain, more instructive, of more universal application, and therefore far more intelligible by the beginner, than one founded upon the physical characters.

Assuming then, a chemical basis for the arrangement, another point was still open for determination; namely—where to begin. Hence it became requisite to seek a sufficient reason for establishing, (instead of beginning arbitrarily without any apparent motive) some precise order of description, founded upon an intelligible principle, and such an one as should begin with the most simple, and terminate with the most compound substances. And viewing the intimate connexion existing between mineralogy and geology, as a fact which cannot be too early impressed on the mind of the beginner, it seemed that a sufficient motive might be found in this connexion to determine a preference.

The localities of minerals tend to shew that there does exist a more or less certain criterion for determining the relative ages of the earths and the metals, (see p. lv. and p. lxvi.)

Some of the earths chiefly constitute those rocks which are esteemed to be of the oldest formation; while others do not enter into the composition of rocks, being found only in the veins which traverse them; these therefore may be estimated as being of later origin than the former.

Of the alkalies and acids as mineral constituents, either combined with the earths or with each other, the former claim the precedence, as entering into the composition of the oldest rocks. (p. lxiv.)

Two or three of the metals occur in small quantity in the masses of some of the earlier rocks; but in general the metals are found in veins; some in veins traversing the older rocks, and rarely or never in those of a newer kind; others most abundantly or only in those of newer formation.

As rocks are constituted chiefly of earths, and metals are principally found in veins, earthy minerals may be assumed to be of earlier origin than the metalliferous; and hence minerals appear to possess a claim to a somewhat *natural order of succession in our cabinets.*

Thus, siliceous minerals are first described, because it is estimated that silex forms the largest proportion of the oldest and most abundant primitive rocks: and all earthy minerals of which silex is the largest ingredient, are arranged under that head; beginning, chemically, with silex in its purest form, and proceeding to such as consist of that and another earth, as silex and alumine, then to those consisting of silex and lime, &c. and afterwards to such minerals as are chiefly constituted of three or more earths, terminating with the most compound; and regarding the iron, manganese, &c. involved in many of them, only as accidental ingredients. The other earthy minerals are proceeded with in like manner; arbitrarily selecting such as contain the rare earth glucine, and placing them under that head, except that the gadolinite, which also contains the still more rare earth yttria, is placed under the latter.

Next after those minerals which consist only of one or more of the earths, succeed those in which one or other of the alkalies is found: to these, such of the acids as occur in the concrete state; then those minerals which are primarily constituted of one or more earths and an acid, and after these, those consisting of an alkali and an acid; and finally the very few in which an earth, an alkali, and an acid, are combined together.

Then follow those minerals (chiefly earthy) which have not been analysed, or of which but little is known.

The native metals and metalliferous minerals succeed, arranged according to the order of age and formation (see p. lxvi); subordinately beginning with the metal in its native state, when it so occurs; then its combination with other metals, when in the state of a natural alloy; then combined with sulphur; with oxygen; and finally as an oxide, combined with an acid.

The combustibles follow, beginning with sulphur, to succeeds carbon in its purest form, and afterwards its se combinations with other bodies, as the base of the greate of all the substances belonging to this class.

The order of arrangement is therefore as follows:

Earthy Minerals.
Alkalino-earthy Minerals.
Acids.
Acidiferous earthy Minerals.
Acidiferous alkaline Minerals.
Acidiferous alkalino-earthy Minerals.
Minerals (chiefly Earthy) which have not been anal or of which but little is known.
Native Metals and Metalliferous Minerals.
Combustibles.

TABULAR ARRANGEMENT.

ews the order of description of individual minerals. Every
n each compound mineral is not noticed in this table. In
., the &c. relates to the small portions of oxide of iron, oxide
e and sometimes of water, which many of them contain. The
alysis is included in the description. The figures refer to the
ich they are described.

Earthy Minerals.

.... **Quartz 1**
- crystallized
- massive
- enclosing water and air
  - pearl spar
  - bitumen
  - bitumen and water
  - titanite
  - oxide of iron
  - mica (avanturine) 4
  - actynolite (prase)
- coloured; milk
  - rose
  - violet (amethyst) 5
  - yellow
  - brown
  - ferruginous (Eisenkeisel) 6
  - irisated
- radiated
- stalactitic 7
- pseudomorphous
- spongiform
- fat or fetid 8
- Hyalite
- granular 9
  - flexible
- arenaceous (sand)

Cat's-eye

Opal 10
- Precious, or noble
- Fire
- Common 11
- Semi
- Wood 12
- Ferruginous

SILEX, *Alumine*, &c. .... Hydrophane
- Menilite 13
- Flint
  - ferruginous
- Chalcedony 14
  - Pseudomorphous
  - Onyx
  - Sard 15
  - Sardonyx
  - Plasma
  - Heliotrope
  - Chrysoprase
  - Cacholong 16
  - Carnelian
  - Agate 17
    - ribbon
    - brecciated
    - fortification
    - mocha-stone
    - moss
- Jasper 18
  - common
  - striped or ribbon 19
  - Egyptian (or pebble)
  - Porcelain 20
  - Agate-jasper
  - Ruin-jasper
- Hornstone 21
  - pseudomorphous
  - Wood-stone
  - Chert
- Leelite
- Siliceous sinter, 22
  - opaline
  - pearl sinter

——, ———, *water* .... Karpholite

——, *lime*, &c................. Tabular spar 23
- Jeffersonite 24
- Lievrite

——, *magnesia*, &c............. Bronzite 25

——, *alumine*, *lime*, &c. .... Garnet 26
- Almandine
- Common 27
- Pyrenite 28
- Grossular
- Aplome 29
- Manganesian
- Melanite 30
- Allochroite
- Colophonite
- Pyrope 31
- Topazolite
  - Succinite 32

LEX, alumine, lime, &c. ..... Cinnamon-stone
- Romanzovite 34
- Idocrase
  - Egeran 35
- Gehlenite
- Prehnite 36
  - Koupholite
- Stilbite 37
- Heulandite 38
- Thomsonite 39
- Scolezite 40
- Wernerite
- Zoisite 41
- Epidote
  - crystallized 42
  - granular
  - manganesian
- Axinite 43
- Indianite 44
- Lapis Lazuli
- Dipyre 45
- Laumonite
- Slates 46
  - Clay-slate
  - Flinty-slate 47
    - Lydian-stone
  - Whet-slate 48
  - Alum-slate
- Clays
  - Wacké 49
  - Iron-clay
  - Indurated clay
  - Slate-clay
    - black bituminous 50
    - brown bituminous
    - rotten-stone
  - Adhesive-slate
  - Polishing-slate 51
  - Porcelain-clay
  - Lithomarge 52
  - Fuller's-earth
  - Tripoli 53
  - Bole
  - Lemnian Earth 54
  - Cimolite
  - Mountain-meal
  - Black chalk 55
  - Pipe-clay
  - Potter's clay
  - Loam 56

- *SILEX, alumine, magnesia* .... Fahlunite
- ——, ———, *barytes*, &c....... Harmotome
- ——, *lime, magnesia*, &c........ Amianthoide
  - Byssolite 58
- Augite or Pyroxène
  - Diopside or Alalite 60
  - Pyrgom or Fassaite
  - Sahlite 61
  - Baikalite 62
  - Euchysiderite
  - Coccolite
- ——, *alumine, lime, magnesia*, &c. Hornblende 63
    - crystallized
    - massive
    - slate
    - basaltic 64
  - Pargasite 65
  - Hedenbergite 66
  - Carinthin
  - Tremolite
      - granular 67
      - fibrous
      - asbestiform
    - Calamite
    - Pyrallolite
  - Actynolite 68
    - crystallized
    - asbestiform
    - glassy
- Anthophyllite 69
- Hypersthene 70
- Schiller spar 71
- Smaragdite
- Asbestus
  - Amianthus 72
  - Common asbestus
  - Mountain leather 73
  - ——— cork
  - ——— wood
- *ALUMINE*, &c. .... Corundum 74
  - Perfect corundum
    - Sapphire
    - Oriental ruby 75
  - Common corundum 76
  - Emery 78
- ———, *water* .... Diaspore
- Gibbsite 79
- Calaite
- ———, *silex*, &c. .... Fibrolite 80
- Pinite
- Kyanite 81
  - Rhætizite

ALUMIME, *silex*, &c.	**Staurolite 82**
	Automalite 83
	Topaz 84
	Pyrophysalite 86
——, ——, *water*	**Siliciferous hydrate of alumine**
	Severite 87
	Lenzinite
	opaline
	argillaceous
	Kollyrite 88
	Allophane
——, ——, *lime*, &c.	**Pycnite 89**
	Chrysoberyl
——, *magnesia*, &c.	**Spinelle ruby 90**
——, *silex*, *magnesia*, &c.	**Pleonaste 92**
——, ——, *lime*, *magnesia*	**Iolite**
	Pelium
	Steinhelite
	Lazulite 94
MAGNESIA, *water*	**Hydrate of magnesia 95**
——, *silex*	**Chrysolite**
	Olivine 96
	meteoric
	Condrodite 97
——, *silex*, *alumine*, *lime*, &c.	**Serpentine**
	noble
	common 98
ZIRCON, *silex*, &c.	**Zircon 99**
	Hyacinth
	Jargoon
	Zirconite
GLUCINE, *silex*, *alumine*, &c.	**Euclase 101**
——, ——, ——, *lime*, *iron*,	**Beryl 102**
——, ——, ——, —, *chrome*	**Emerald 104**
YTTRIA, *glucine*, *alumine*, &c.	**Gadolinite 105**

Alkalino-Earthy Minerals.

SILEX, *alumine*, *potash*, &c.	**Mica 106**
	Leucite 107
	Andalusite 108
	Bucholzite 109
—, *lime*, *potash*, &c.	**Apophyllite 110**
	Albin

SILEX, *alumine, lime, potash*, &c.	Scaly Talc 111	
	Haüyne	
	Pearlstone 112	
	Gieseckite 113	
	Felspar	
		Adularia
		common 114
		glassy 115
		Labradore
		blue
——, *magnesia, potash*, &c.	Talc 116	
		crystallized
		massive
		indurated
	Green Earth 117	
——, *alumine, magnes. potash*, &c.	Soapstone 118	
		Steatite
		Potstone
		Agalmatolite
	Chlorite 120	
		crystallized
		compact
		slate
		earthy
	Schorl 121	
	Killinite 122	
——, *zircon, lime, soda*, &c.	Eudyalite	
——, *alumine, lime, soda*, &c. ...	Mesotype 123	
		Natrolite 124
		Mesolite, or
		Needle-stone 125
	Sommite	
		Pseudo Sommite
	Rubellite 126	
	Sodalite 127	
	Spinellane	
	Lythrodes 128	
	Analcime 129	
	Clinkstone 130	
	Pitchstone	
	Lava 131	
——, ——, —, *magnesia, soda*, &c.	Basalt 132	
——, *alumine, potash* & *soda*, &c.	Pumice 133	
	Compact Felspar	
——, ———, *lime, potash* & *soda*	Jade 134	
		common
		Axe-stone
		Saussurite
	Obsidian 135	
		Marekanite

SILEX, alumine, lime, pot. & soda	Fettstein 136
	Scapolite 137
	Chabasie 138
——, ———, *magnesia*, &c.	Gabronite 139
——, ———, *potash, lithia*	Tourmaline
	black
	blue and green
	clear blue
	dark blue
	Lepidolite 141
——, ———, *lithia*, &c.	Petalite 142
	Spodumene
——, ———, *lime, soda, lithia*, &c.	Meionite 143

Acids.

SULPHURIC acid	Native 144
BORACIC acid	Native

Acidiferous Earthy Minerals.

ALUMINE, sulphuric acid	Subsulphate of alumine 145
———, *phosphoric acid*	Wavellite 146
LIME, carbonic acid	Carbonate of lime 147
	Calcareous spar
	Schiefer spar 149
	Satin spar 150
	Agaric mineral
	Aphrite
	Stalactitic 151
	Stalagmite
	Granular limestone 152
	Common limestone 153
	Secondary marble 154
	Verd antique
	Lumachelli
	Cotham
	Swinestone 156
	Bituminous limestone
	Argillo-ferruginous
	Calp
	Aberthaw
	Septaria
	Oolite 157
	Peastone
	Chalk
	grey
	Marle
	chalk-marle
	bituminous
	Madreporite 160
	Tufa

LIME, carbonic acid, water	Hydro-carbonate of lime 161
——, ———, *strontian*	Arragonite
	crystallized
	Flos Ferri
	fibrous
——, *magnesia, carbonic acid*	Bitterspar 163
	Miemite
	Conite
	Pearl-spar 165
	Dolomite
	Gurhofian
	Magnesian limestone 166
——, *phosphoric acid*	Apatite 167
	Phosphorite
——, *fluoric acid*	Fluor 168
	crystallized
	nodular
	compact
	earthy
	Chlorophane
——, *sulphuric acid*	Anhydrite 173
	crystallized
	granular
	fibrous
	compact
	siliciferous
——, —————, *water*	Gypsum 174
	crystallized
	fibrous
	plumose
	granular
	compact
	earthy
——, *nitric acid, water*	Nitrate of lime 177
——, *boracic acid, water*	Datholite
	Botryolite
——, *arsenic acid, water*	Pharmacolite 178
MAGNESIA, carbonic acid	Carbonate of magnesia 179
	crystallized
	compact
	earthy
	pulverulent
————, *sulphuric acid*	Sulphate of magnesia 180
————, *boracic acid*	Boracite 181
BARYTES, carbonic acid	Witherite 182
	crystallized
	stalactitic
	massive

BARYTES, sulphuric acid	Heavy spar 183
	crystallized
	stalactitic
	Stangenspath
	massive
	fibrous
	Bolognian stone
	granular
	Cawk
	earthy
	Hepatite
STRONTIAN, carb. acid, water	Strontianite 186
	crystallized
	fibrous
	stellated
	massive
———, ———, *barytes, lime*	Barystrontianite 187
———, *sulphuric acid*	Celestine
	crystallized
	fibrous
	stellated
	massive

Acidiferous Alkaline Minerals.

POTASH, nitric acid	Nitre 189
	crystallized
	capillary
	investing
SODA, carbonic acid	Natron 190
	crystallized
	fibrous
	massive
	investing
	efflorescing
——, *sulphuric acid*	Sulphate of soda 191
——, *nitric acid*	Nitrate of soda
——, *boracic acid*	Borax 192
	Tincal
——, *muriatic acid, &c.*	Common salt 193
	crystallized
	fibrous
	massive
AMMONIA, sulphuric acid, water	Sulphate of ammonia 194
———, *muriatic acid*	Muriate of ammonia 195
	crystallized
	fibrous
	investing
	massive

Acidiferous Alkalino-Earthy Minerals.

ALUMINE, *sulph. acid, potash* . Alum 197
crystallized
efflorescing
stalactitic
——, *silex, sulph. acid, potash* . Alum-stone
——, *fluoric acid, soda, water*.. Cryolite 198
——, *phosph. ac. fluor. ac. lithia*, Amblygonite

LIME, *soda, sulphuric acid* ..... Glauberite
——, *magnesia, potash, soda, sulphuric acid, muriatic acid, water* .... } Polyhallite

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Brewsterite	200	Limbilite	208
Comptonite	201	Margarite	—
Chiastolite	—	Melilite	—
Chusite	202	Necronite	—
Chlorophæite	—	Omphacite	209
Couzeranite	203	Picrolite	—
Domite	—	Sphærulite	—
Fuscite	204	Siderite	210
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IRON .... Native iron 213
Volcanic
Meteoric
——, *arsenic* .... Mispickel 215
argentiferous
——, *sulphur* .... Iron pyrites 217
crystallized
radiated
hepatic
arsenical
auriferous
seleniferous
pseudomorphous

IRON, sulphur	White Iron Pyrites 220
	Magnetic Iron Pyrites 221
——, *oxygen*	Oxydulated Iron
	crystallized
	lamelliform
	earthy
	titaniferous
	chromiferous
	Specular Iron 224
	crystallized
	lamelliform
	volcanic
	micaceous
——, ——, *zinc*	Franklinite 226
——, ——, *water*	Hydrous Oxide of Iron 226
	Stilpnosiderite
	Cronstedite
——, ——, &c.	Red Iron-ore 228
	fibrous (hæmatite)
	compact
	scaly
	red ochre
	red chalk
	Brown Iron-ore 230
	crystallized
	fibrous
	compact
	scaly
	ochery
	Umber
	Black Iron-ore 232
	fibrous (hæmatite)
	compact
	ochery
	pea iron-ore
	Jaspery Iron-ore 233
——, ——, *mangan. phosph. ac.* &c.	Bog Iron-ore 234
	friable
	indurated
	compact
——, ——, *sulphuric acid*, &c.	Pitchy Iron-ore 235
——, ——, *mang. muriatic acid*	Pyrosmalite 235
	crystallized
	massive
——, *carbonic acid*	Spathose Iron 236
	crystallized
	lenticular
	massive
	Clay Iron-stone
	massive
	columnar
	lenticular

IRON, phosphoric acid	**Phosphate of Iron 238**
	crystallized
	earthy
——, *sulphuric acid*, &c.	**Green Vitriol 240**
	crystallized
	stalactitic
	massive
	pulverulent
——, *chromic acid*	**Chromate of Iron 240**
	crystallized
	massive
——, *arsenic acid, water*, &c.	**Arseniate of Iron 241**
——, *oxalic acid*	**Oxalate of Iron 242**
MANGANESE, oxygen	**Grey oxide 243**
	crystallized
	radiated
	fibrous
	massive
	compact
	earthy (Wad)
———, ——, *silex*	**Helvin 244**
———, ——, *iron, silex*, &c.	**Siliciferous oxide 245**
———, ——, *sulph. carb. acid*	**Sulphuret of Manganese 246**
———, ——, *iron*, ———	**Carbonate of Manganese 246**
	Allagite
	Rhodonite
	Photizite
	Hornmangan
———, ——, ——, *phosph. acid*	**Phosphate of Manganese 248**
MOLYBDENA, sulphur	**Sulphuret of Molybdena 248**
	crystallized
	lamelliform
————, *oxygen*	**Oxide of Molybdena 249**
TIN, oxygen	**Oxide of Tin 250**
	crystallized
	fibrous (Wood Tin)
	toad's-eye 253
	granular
	columbiferous
——, *copper, iron, sulphur*	**Sulphuret of Tin 254**
TUNGSTEN, oxygen	**Oxide of Tungsten 255**
TUNGSTIC acid, iron, mang. &c.	**Tungstate of Iron 255**
————, *lime*	**Tungstate of Lime 256**
TITANIUM, oxygen	**Anatase 258**
	Titanite 259
	crystallized
	reticulated
———, ——, *iron, manganese*	**Nigrine 259**
	Menaccanite 260
———, ——, ——, *uranium*	**Iserine 260**
———, ——, *silex*	**Crichtonite 261**

TITANIUM, oxygen, silex, lime	Sphene 262
	crystallized
	amorphous
	Spinthère
CERIUM, oxygen, iron, silex, &c.	Cerite 263
	Allanite 264
	Ceriu
——, ——, ——, *mang. yttria*	Orthite 265
	Pyrorthite
——, *yttria, lime, fluoric acid*	Yttrocerite 265
——, *fluoric acid*	Sub-fluate of Cerium 266
	Deuto-fluate of Cerium 266
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URANIUM, oxygen, &c.	Uran-Ochre 267
——, *phosphoric acid,* &c.	Phosphate of Uranium 267
COLUMBIUM, oxy. iron, mang.	Columbite 269
	stanniferous
——, ——, ——, *yttria*	Yttrocolumbite 271
CHROME, oxygen	Oxide of Chrome 271
BISMUTH	Native Bismuth 272
	crystallized
	reticulated
	amorphous
——, *sulphur*	Sulphuret of Bismuth 273
	crystallized
	cupriferous
	plumbo-cupriferous
——, *oxygen*	Bismuth ochre 274
——, *carbonic acid,* &c.	Carbonate of Bismuth 274
ARSENIC	Native Arsenic 275
——, *oxygen*	Oxide of Arsenic 275
——, *sulphur*	Realgar 276
	crystallized
	acicular
	investing
	disseminated
	amorphous
	Orpiment 277
	crystallized
	amorphous
COBALT, arsenic	Bright-white Cobalt 278
	crystallized
	arborescent
	stalactitic
	botryoidal
	amorphous
——, ——, *iron*	Grey Cobalt 279
	crystallized
	lamelliform
	stalactitic

COBALT, *arsenic*, *iron*	Tin-white Cobalt 280
	crystallized
	arborescent
	reticulated
	botryoidal
	stalactitic
	amorphous
——, *sulphur*, &c............	Sulphuret of Cobalt 280
——, *oxygen?*	Earthy Cobalt 281
——, *arsenic acid*, *water*......	Arseniate of Cobalt 281
——, *sulphuric acid*, *water*	Red Vitriol 282
NICKEL....................	Native Nickel 282
——, *arsenic*, &c.	Arsenical Nickel 283
——, *oxygen*, *arsenious acid*, &c.	Nickel-ochre 284
——, ——, *silex*, &c.	Pimelite 284
SILVER....................	Native Silver 285
	crystallized
	granular
	massive
	auriferous 286
——, *antimony*	Antimonial Silver 286
	crystallized
	massive
	arsenical 287
	globular
——, *molybdena?*	Molybdic Silver 287
——, *sulphur*	Sulphuret of Silver 288
	crystallized
	amorphous
	black 288
	massive
	pulverulent
——, ——, *iron*	Flexible Sulphuret of Silver 289
——, ——, *antimony*, *iron*, &c.	Brittle Sulphuret of Silver 290
	crystallized
	massive
	disseminated
	Sulphuret of Silver & Antimony
——, ——, ——, *oxygen*...	Red Silver 291
	crystallized
	dendritic
	massive
	disseminated
——, ——, *copper*	Sulphuret of Silver and Copper
——, ——, *antimony*, *lead*, &c.	White Silver 293
	massive
	disseminated
——, ——, *bismuth*, *lead*, &c..	Bismuthic Silver 294
	acicular
	disseminated

SILVER, *copper*, *selenium*	Seleniuret of Silver and Copper
—, *carbonic acid*, *antimony*, &c.	Carbonate of Silver 295
	massive
	disseminated
—, *muriatic acid*, &c.	Muriate of Silver 295
	crystallized
	acicular
	massive
	investing
	butter-milk Silver
COPPER	Native Copper 296
	crystallized
	acicular
	filiform
	capillary
	dendritic
	massive
——, *sulphur*	Vitreous Copper 297
	crystallized
	massive
	pseudomorphous
	variegated
——, ——, &c.	Buntkupfererz 299
	crystallized
	tabular
	massive
——, ——, *iron*, &c.	Grey Copper 300
	crystallized
	massive
	disseminated
	arsenical
	antimonial
	platiniferous
	Copper Pyrites 302
	crystallized
	stalactitic
	botryoidal
	mamillated
	amorphous
	arsenical
——, *selenium*	Seleniuret of Copper 304
——, *arsenic*, *iron*, *sulphur*	Tennantite 304
	crystallized
	massive?
——, *oxygen*	Red Oxide of Copper 306
	crystallized
	acicular
	capillary
	massive
	ferruginous
	Black Copper 308
	massive
	investing

COPPER, oxygen, carb. ac. wat. Blue Carbonate of Copper 309
crystallized
massive
Green Carbonate of Copper 31
crystallized
fibrous Malachite
massive Malachite
epigène
——, ——, ——, *silex*, &c. . Chrysocolla 312
botryoidal
stalactitic
reniform
massive
investing
——, ——, ——, *lime*, &c. . Dioptase 312
crystallized
——, ——, *sulph. acid, water* Blue Vitriol 313
massive
stalactitic
pulverulent
——, ——, *mur. acid, water* Muriate of Copper 313
crystallized
fibrous
arenaceous
——, ——, *phosphoric acid*. . Phosphate of Copper 314
crystallized
fibrous
——, ——, ——, *water* . . Hydrous Phosphate of Coppe
crystallized
fibrous
——, ——, *arsenic acid, water* Arseniate of Copper 316
crystallized
Octohedral
Rhomboidal
Oblique prismatic
Right prismatic
amianthiform
hæmatitic
——, ——, *arsenic acid, iron* Martial arseniate of Copper 3
crystallized
Skorodite 321
GOLD . . . . Native Gold 322
crystallized
ramose
in grains
massive
argentiferous
PLATINA . . . . Native Platina 324
PALLADIUM . . . . Native Palladium 325
and OSMIUM . . . . . Native Alloy 326
crystallized
in grains

TELLURIUM, *gold*, &c.	Native Tellurium 326
	Graphic Tellurium 327
	Yellow Tellurium 328
	Black Tellurium 328
ANTIMONY	Native Antimony 329
	reniform
	amorphous
———, *sulphur*	Sulphuret of Antimony 329
	crystallized
	massive
	disseminated
	acicular
	plumose
	compact
———, *oxygen*, *sulphur*	Red Antimony 331
	acicular
	amorphous
———, *oxygen*	White Antimony 331
	crystallized
	acicular
	massive
	Antimonial Ochre 332
	investing
LEAD, *sulphur*	Galena 332
	crystallized
	lamelliform
	granular
	compact
	specular
	antimoniated
	argentiferous
	supersulphuret of lead
	Blue Lead 335
	prismatic
	massive
———, *antimony*, *copper*, *sulphur*	Bournonite 336
	crystallized
———, *oxygen?*	Native Minium 337
	amorphous
	pulverulent
———, ———, *alumine*, *water*, &c.	Plombgomme 338
———, ———, *carbonic acid*, *water*	Carbonate of Lead 338
	crystallized
	massive
	lead-grey
	blue and green
	acicular
	scaly
	earthy

LEAD, *oxy. carb. & sulphuric acids*	**Sulphato-carbonate of Lead 3**
	Sulphato-tri-carbonate of Le
——, ——, ——, ——, *copper* ..	**Cupreous sulphato-carbonate Lead 342**
——, ——, *muriatic & carb. acids*	**Murio-carbonate of Lead 34**
——, ——, *phosph. & muri. acids*	**Phosphate of Lead 344**
	crystallized
	botryoidal
	reniform
	massive
	brown
	arseniated
——, ——, *arsenic & muri. acids*	**Arseniate of Lead 345**
	crystallized
	mamillary
	compact
	reniform
——, ——, *sulphuric acid, water*	**Sulphate of Lead 346**
	crystallized
	massive
——, ——, ————, *copper* ...	**Cupreous Sulphate of Lead**
——, ——, *molybdic acid*	**Molybdate of Lead 348**
	crystallized
	massive
——, ——, *chromic acid*	**Chromate of Lead 349**
	crystallized
——, ——, ————, *copper* ...	**Vauquelinite 350**
——, ——, *tungstic acid*........	**Tungstate of Lead 350**
ZINC, *sulphur*	**Blende 351**
	crystallized
	massive
	phosphorescent
	fibrous
	mamillated?
	cadmiferous
——, *oxygen, manganese,* &c....	**Red oxide of Zinc 353**
	lamelliform
——, ——, *silex, water*	**Siliceous oxide of Zinc 354**
	crystallized
	radiated
	stalactitic
	mamillated
	massive
——, ——, *carbonic acid*	**Calamine 355**
	crystallized
	compact
	pseudomorphous
	earthy
	cupriferous
——, ——, *sulphuric acid*	**White Vitriol 356**

QUICKSILVER	Native Quicksilver 357
———, *silver*	Native Amalgam 357
	crystallized
	massive
	semi-fluid
———, *sulphur*	Cinnabar 358
	crystallized
	fibrous
	granular
	massive
	pulverulent
	hepatic
	bituminous
———, *oxy. mur. & sulph. acids*	Horn Quicksilver 359
	crystallized
	investing
	massive

Combustible Minerals.

SULPHUR	Native Sulphur 360
	crystallized
	massive
	disseminated
	investing
	Volcanic Sulphur 361
	crystallized
	massive
	investing
	cellular
CARBON	Diamond 361
	Mineral Carbon 364
———, *iron*	Plumbago 364
———, —, &c.	Anthracite 365
	massive
	slaty
	Blind Coal
	Stone Coal
	Welch Culm
	Kilkenny Coal
	columnar
———, *hydrogen*	Mineral Oil 366
	Naptha
	Petroleum
———, ———, &c.	Bitumen 368
	earthy (Maltha)
	elastic
	compact (Asphalt)

CARBON, hydrogen, &c.	Black Coal 370 Cannel Coal 371 Jet 371 Brown Coal 372 Moor Coal Wood Coal Surturbrand Bovey Coal Dysodile 372
———, *succinic acid*	Amber 373
———, &c.	Hatchetine 374
ALUMINE, mellitic acid	Mellite 374
EARTH, resin, asphalt	Retinasphalt 375 Highgate Resin 375

Named in Sowerby not in Phillips

Burnt Rock
Turf or Peat
Alluvial Deposit
Mould
Ice or Hail

APPENDIX.

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Latrobite	380
Leuttrite	381
Black Manganese	—
Ratboffite	—
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Note.

Letters and figures in the Margins
Black Roman Figures refer to
Plates in Sowerby's British
Mineralogy.
Red, with letter E prefixed refer
to Exotic Mineralogy, and Italian
Numbers to the order of both in
which they are arranged and bound,
in their respective series British and
Exotic.
British 4 Vol. Exotic 2 Vol.

EARTHY MINERALS.

Under this head are included such minerals as consist of one earth or more, together with such occasional and variable proportions of iron, manganese, water, and even of acids, as induce the conclusion that they are only accessory constituents. We shall begin with Silex in its purest form, as being the oldest and most abundant mineral, and as affording the most simple arrangement; and then proceed to all such minerals as by the most authentic analyses, appear to consist chiefly of silex. Those of which alumine forms the greatest proportion succeed, as being the earth next in age and abundance. Magnesia follows; then such minerals as consist primarily or in part of zircon, or glucine, or lastly of yttria.

QUARTZ.

Quarz, W. and H.

Under the term Quartz, are comprehended many minerals which are considered as varieties of it, because they consist almost entirely of silex. They differ considerably in some of their external characters, in others however they mostly agree: they are all sufficiently hard to scratch glass; when compact enough, they mostly give fire with the steel; do not yield to the knife, and alone are infusible before the blow-pipe, by exposure to which the coloured varieties generally lose their colour; and Berzelius seems of the opinion that the small quantity of water afforded by some varieties is only hygrometric, and therefore varies with the state of the atmosphere. The specific gravity of the purer kinds is about 2.6.

Quartz occurs massive and crystallized; the crystals sometimes include foreign substances, as chlorite, &c.; and they are found of various colours; quartz also occurs in stalactites, pseudomorphous, spongiform, granular, compact, and is sometimes of a greasy lustre (fat quartz,) &c.

1. CRYSTALLIZED QUARTZ.

Berg Crystal and Gemeiner Quarz, W. Quarz Hyalin,* H.

There does not appear to be any specific difference betwee
1 XLI common quartz and rock crystal; the latter term was formerl
confined to the large transparent crystals of Madagascar, th
2 XLII Alps, &c.; but the small and even minute transparent crystal
occurring in almost all metalliferous veins, do not differ fro
3 CXCIX rock crystal, either in chemical or external characters.

The common form of the crystals of quartz, is a six-side
4 CXV prism terminated by six-sided pyramids; the two pyramid
joined base to base (fig. 3) without an intervening prism ar
5 CCXLII rarely seen. The crystals may be cleaved, presenting brillian
surfaces, parallel to all the planes of the dodecahedron wit
6 CCXLII triangular planes (fig. 3), which might therefore be considere
as the form of the primary crystal of quartz, but the obtus
7 CCXCVII rhomboid has been adopted as a more simple form: the con-
nection between this rhomboid and the dodecahedron with tri-
8 CCCXVIII angular planes will be perceived by consulting figs. 1, 2, & 3
The angles of the primary rhomboid are, 94° 15′ and 85° 45′
9 CCVIII according to coinciding measurements by the reflecting gonio-
meter taken both on cleavages and natural planes. The cros
10 CCVII fracture is often perfectly conchoidal. Transparent quartz i
composed of silex and 2 or 3 per cent. of water, considered b
Berzelius to vary with the state of the atmosphere.

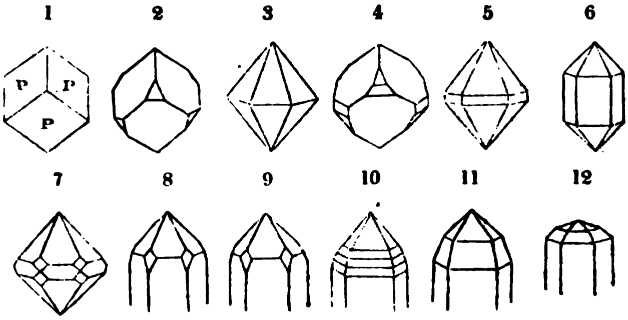

Fig. 1. The primary rhomboid. Fig. 2. The lateral angles replaced b triangular planes; which are complete in fig. 3. having converted the rhom boid into a dodecahedron with triangular planes. Fig. 4 shews the smal triangular planes connected with four-sided planes, which are parallel wit the axis of the crystal (Bornholm diamonds). Fig. 5, the four-sided plan complete. Fig. 6, the four-sided plane elongated, being the common crysta of quartz. Fig. 7, shews a rhombic plane on each of the lateral angles of th

dodecahedron. Haüy describes them as occurring only on alternate angles; but they occur as described in fig. 7 among the Bornholm diamonds. Fig. 8 shews an irregular four-sided plane on the upper left corner of each plane of the prism of a common crystal; if the crystal was drawn complete, the same plane would be shewn on the lower right corner. Fig. 9 shews the same plane on the upper right corner which frequently occurs: these planes are mostly seen in combination with the rhombic planes of fig. 7. Fig. 10 shews the replacement of the edges between the lateral and terminal planes, by four planes: these mostly occur in combination with the four-sided planes of figs. 8 and 9. Fig. 11 shews one of the four planes increased; tending to a very acute six-sided pyramid, capped by the common pyramid. Fig. 12 shews the replacement of the apex of the common pyramid by six planes, forming a very obtuse pyramid.

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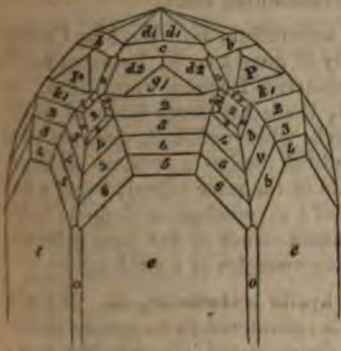
* The meaning of the term Quartz is not known; hyalin, from its vitreou aspect.



P on P	94°15′	
—— *g* 1	103.20	H
P on *k* 1 or *g* 1 on *g* 2	160. 5	
—— *k* 2 — — — *g* 3	156.30	
—— *k* 3 — — — *g* 4	152.20	
—— *k* 4 — — — *g* 5	149.20	
P or *g* 1 on *e*	141.40	H
e on *e*	120	
P on *i* 1 or *g* 1 on *h* 1	165	*c.g.*
P or *g* 1 on *i* 2	151.20	
P on *h* 3 or *g* 1 on *i* 4	151.16	
—— *h* 4 — — — *i* 5	148.50	
—— *h* 5 — — — *i* 6	142.20	
b on *b*	125.10	
P on *b* or *g* 1 on c	160.15	
d 2 on *d* 2	179.15	
d 2 on *g* 1	179.30	

The planes *b b* tend to an obtuse rhomboid, or, in connexion with c, to an obtuse six-sided prism.

The planes *k* 1 to 4 to acute rhomboids, or, in connexion with *g* 2 to 5, to six-sided pyramids more acute than the common one.

The planes *h* 1 to 5 and *i* 1 to 6 occasionally, though rarely, occur on the same crystal.

The planes *n* and *o* are always convex: *d d* are always minute and rough.

The planes *o o* sometimes replace only the alternate edges of the prism.

If two pieces or crystals of quartz be rubbed against each other in the dark, a phosphorescent light is produced, and an odour like that of the electric fluid.

The finest and largest specimens (*rock crystal*) are found in Dauphiné, Madagascar, the Alps, &c. in cavities in veins; the lesser and more transparent occur in almost every metalliferous vein, and there are few mineral substances that are not accompanied by quartz. The finest and most transparent specimens of Britain, are from the slate quarries of Dennibole, on the northern coast of Cornwall; inferior specimens are found on Snowdon in Wales, and in Aberdeenshire. The primary rhomboid has been found in a decomposing porphyritic rock near Swan Pool in Cornwall. The double hexahedral pyramid, or dodecahedron with triangular faces, has been found near Bristol, and at Craig-Lockart, near Edinburgh.

Crystals of quartz are found *enclosing* various substances, as water, air, bitumen, (the latter occurs in Derbyshire, but I possess a crystal containing all three); primary crystals of pearl spar (Cornwall); crystallized titanite; oxide of iron; and according to Jameson, the following substances, epidote, schorl, asbestus, actynolite, hornblende? fluor? heavy spar, native silver, specular iron-ore, grey antimony, and arsenical pyrites. Quartz is also found containing mica.

Avanturine.[*] Quartz hyalin avanturine, H. Dr. Mac Culloch considers it to be a variety of quartz rock, between which and mica slate he has observed frequent transitions. In Glen Fernat in Scotland, there are large beds of quartz rock including mica, which, when polished, does not yield to some of the most beautiful foreign specimens of avanturine of Spain, though not of the same colour, being a fine blue grey: it also occurs of a grey colour at Cape de Gatte in Spain. The most common colour of the base is brown, or reddish brown, enclosing spangles of a gold colour.

Prase. Prasem, W. Quarz hyalin vert-obscur, H. It is of a dark green colour,[†] and is considered to be quartz enclosing actynolite, equally disseminated through the mass; which often is penetrated by long and distinct fibres of actynolite.

It has been found in Scotland by Dr. Mac Culloch forming veins in gneiss.

Milk Quartz. Milch quarz, W. Quarz hyalin laiteux, H. As its name denotes, it is nearly of the colour of milk. It occurs both crystallized and massive. When crystallized it is remarkable that the crystals are of more regular forms than transparent quartz; the same observation applies to almost all coloured quartz. The blueish white varieties are employed in jewellery.

Rose Quartz. Var. of Milch quarz, W. Quarz hyalin rose, H. Crystallized and massive. Occurs in beds in granite in Bavaria and Bohemia; in flinty slate in the Harzberg forest; at Abo in Finland; among granite and gneiss in America;

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[*] It is said to be derived from the French, par avanture; a workman having first found it by accident?

[†] Its name is derived from the Greek, signifying leek; in allusion to its colour.

is supposed to derive its colour from manganese: when cut and polished, it has been sold for the Ruby; and is sometimes called the *Bohemian Ruby*.

Violet Quartz. *Amethyst.*[*] Amethyst, W. Quartz hyalin violet, H. The amethyst chiefly differs from common quartz, in its colour, which is occasionally of every shade of violet, or rather purplish violet, which in the perfect amethyst is pretty equal through the mass: more commonly the summits of the crystals only are amethystine, the lower part being nearly colourless or tinged with green. But the crystals are usually aggregated or fasciculated, and separate in the form of irregular columns; they are sometimes radiated and diverge from a center. According to Rose the amethyst contains a very small proportion of iron and manganese, to which its colour is supposed to be owing: it becomes white and opalescent by long exposure to heat. The best amethysts are brought from Cambay in India, from Siberia, and from Spain. CCCCXX (12)

The amethyst is found in veins in primitive and secondary mountains; lining the cavities of geodes, which frequently are coated with agate. In Europe, it is found in Sweden, the Hartz, Bohemia, Silesia, Transylvania, Spain, France, &c.; in agate balls at Oberstein in Germany. In Asia, in Siberia, India, Persia, and Ceylon. In several places in the United States of America, and in South America.

In England, it occurs in the tin mines of Polgooth and Pednandræ, and at Botallack mine near the Land's End. In Scotland, in the traps of Fifeshire and the hill of Kinnoul. In Ireland, near Cork.

Yellow Quartz. Quarz hyalin jaune, H. It is of various shades of yellow, and nearly transparent, and has been termed the *Bohemian* and *Scotish topaz.* It is found in Bohemia; in Pennsylvania: in this country in several of the mines of Cornwall, and very fine at Cairngorm in Scotland. CII (13)

Brown Quartz. Quarz hyalin enfumé, H. The difference between this variety and commom quartz or rock crystal, is not known. It occurs chiefly in the cavities of veins or beds of primitive countries, and sometimes encloses crystals of titanite, &c. and is found in various parts of the European Continent.

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[*] Amethyst, from the Greek, signifying, not drunk; the wearing of it was considered by the ancients as an antidote to drunkenness.

Scotland furnishes some of the finest crystals, and of various shades of brown; they are chiefly found near Cairngorm in Aberdeenshire, in alluvial soil, together with beryls and topazes. I am not aware that any have certainly been found in England. The yellowish varieties are termed smoke topazes.

Ferruginous Quartz. Eisenkiesel, W. Quarz hyalin rubigineux, H. Iron flint, J. Ferruginous quartz, A. This mineral is of various shades of yellow and red, and occurs both massive and crystallized. The massive is frequently crystallized on the surface, and the cavities contain crystals of the common form of quartz. The fracture of the massive is small conchoidal. It is opaque, and gives sparks with the steel. It appears, according to Bucholz, to consist chiefly of silex, with about 5 per cent. of iron and 1 of volatile matter. Some specimens yielded a small quantity of manganese. There are at least two varieties; the preceding, commonly termed *Eisenkiesel*; the other, called the *hyacinth of Compostella*, is found near Compostella in Spain, in sulphate of lime, and near the Blue ridge in Washington County, North America, in the form of a six-sided prism, terminated by six-sided pyramids, generally very perfect, and of a yellowish, or reddish brown colour, and opaque. Eisenkiesel is found in Bohemia, Germany, Franconia; in ironstone veins in the Hartz, and at Altenberg, in Upper Saxony. In Siberia. CXIX

(14) In England, Eisenkiesel occurs near Bristol: in Scotland, in trap rocks near Dunbar; and in trap rocks in the Isle of Rathlin, off the coast of Ireland.

Irisated Quartz. Quarz hyalin irisé, H. This variety shews a play of the prismatic colours, either externally or internally. When external, it is supposed to be owing to the deposit of some metallic oxide, probably of iron. When internal, it is the refraction of light in consequence of fissures in the crystal, and it will often be found that these fissures are straight, and parallel with one or other of the planes of the pyramid. This appearance may be produced by plunging a heated crystal in cold water; the laminæ then partially separate in the direction of the natural joints.

Radiated Quartz. Quarz hyalin fibreux, H. It occurs in crystals which are closely aggregated, and which radiate from a point; the crystals may sometimes be separated, and they then are pointed at the end opposed to the pyramid, which usually appears. :CXIII (15)

It is found with native copper at H. Virgin mine near St. Die, and near Scorrier in Cornwall, and in Jersey; the pyramids are frequently red.

Stalactitic Quartz. This variety has been found in the veins of Huel Alfred Copper mine in Cornwall; it has in no respect the appearance of chalcedony, since it consists of straight stalactites several inches in length, composed of an aggregation of crystals diverging from a center, the pyramid of the crystal appearing on the surface. It has also been found at Botallack Copper mine near the Land's End.

Pseudomorphous Quartz. Quartz hyalin pseudomorphique, H.
Quartz is sometimes found in the form of the crystals of
other substances. Pseudomorphous quartz is of two kinds. CCCLXXX
It has invested other substances, which have since been
decomposed, leaving the quartz hollow, or partially so, and (16)
in the form of the crystals on which it was deposited.
Such are the quartz in the form of calcareous crystals from near Bristol; it also occurs in the form of the cube and octohedron in Cornwall, and the cube, in Durham; in rectangular flat crystals, heavy spar, Durham. Solid quartz crystals in the form of the cube, were found in Huel Alfred mine, Cornwall; and in the form of the cube and octohedron in St. Agness. A specimen of hollow cubic crystals, probably formed upon fluor, which has been decomposed, is in the collection of the Philosophical Society of Truro; each hollow cube is composed of small crystals, and is nearly filled with water. Pseudomorphous crystals of quartz are also found in the form of the very flat rhomboids of spathose iron. The blue quartz of Kapnick is not pseudomorphous, but in primary rhomboids having regular cleavages.

2. SPONGIFORM QUARTZ.

Schwimmstein, W. Float-stone, J.

The *quarz nectique* of Haüy, is described as occurring in beds
of flint in chalk, at St. Ouen, near Paris; it is of a spongy or CCCCXXXI
porous appearance; is white or greyish white; scratches glass;
and is even intimately united with flint. It consists according (17
to Vauquelin, of 98 parts of silex, and 2 of carbonate of lime.
It swims on water. In the latter and most other respects, it
agrees in character with the *swimming-stone* of our own country, CCXCVII
except that ours obviously has no connexion with flint. It was
found in Relistian copper vein in Cornwall, either white, or of (18)

a yellowish tinge, and connected with a yellow copper, which also is cellular, and supernatant. It has also been found in Tin Croft Mine, of an ochreous brown colour, and in Pednandrae Tin Mine: one specimen had externally the appearance of swimming stone; but fluor, rounded and partially decomposed, was still visible in the cavities; on breaking it, it was found to consist of a mass of fluor that had been broken into small angular pieces, which were again cemented by a siliceous deposition having filled up the internal fissures. The white disintegrated pebbles found in the sands of the plastic clay formation at Headen hill in the Isle of Wight, much resemble this substance.

Spongiform quartz floats on water only until the air contained in a very considerable proportion of its numerous cavities has been displaced by the water.

3. FAT OR FETID QUARTZ.

Quarz hyalin gras, H.

Quartz, both crystallized and massive, sometimes exhibits, when fractured, a greasy polish on the surface, equal to what would be produced by rubbing it with oil. It sometimes gives out a fetid odour when struck; but not always. A quartz, having a resinous lustre, is found as an ingredient of a coarse-grained granite, near Nantes, in France, and in loose masses with felspar and garnet at Topsham, in Maine County, North America, which, when struck with a hammer, gives out a fetid odour, resembling that of hygrogen gas.

;CIV
(2

4. HYALITE.* MULLER'S GLASS.

Hyalit. W. Quarz hyalin concretionné, H.

It bears a strong resemblance to gum-arabic, and occurs in botryoidal masses, or in stalactites. It has a vitreous lustre, is brittle, but is as hard as quartz. Its specific gravity is about 2.4. It is infusible by itself before the blowpipe. It consists, according to Bucholz, of silex 92, water 6.3, and a trace of alumine.

This singular mineral is chiefly found investing, or lining the cavities of amygdaloidal trap or basaltic rocks. It occurs at Frankfort on the Maine in basalt; in Mexico, in veins of opal traversing porphyry; in the United States, in the Burhstones of Georgia. It is said also to occur in Silesia, in Italy, and in Hungary, which yields the best specimens.

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* From the Greek, glass; in allusion to its glassy appearance.

5. GRANULAR QUARTZ.

Quarz hyalin granulaire, H.

It occurs white, yellowish, or greyish white, in mass, and as
a component of some granites. Its parts sometimes possess but CCCLXII
little cohesion, and occasionally the mass is a sandstone without (19)
cement: such is a sandstone found in Bedfordshire. Granular
quartz and mica are found at Schihallien in Scotland. In snow-white masses resembling sugar at Hinsdale in Massachussets.

A *flexible* granular quartz is found in Brazil, and near St. CCCCIII
Gothard; the latter appears to consist of irregular particles of
quartz without cement, and only partially united. A variety (20)
of a reddish brown colour occurs in the north-eastern coast of
England, I believe not far from Whitby: it is very flexible.

6. ARENACEOUS QUARTZ. SAND. CCCCVII (21)

Quarz hyalin arenacé H.

There are varieties of Sand which are of a pure white or nearly CCCCXIII
so, and being without any foreign admixture, appear to have (22)
resulted from the destruction of quartz. Such are the sands of XXXI (23)
the coast of Norfolk, and of Alum Bay in the Isle of Wight, so XL (24)
largely used in the making of glass: a somewhat similar sand is LV (25)
found in the caverns of Reigate in Surry. But sand occurs of CCCCLXXIV
almost every variety of colour. (26)

Vitrified Tubes DXXXVIII (27

CAT's EYE. ELXIII (3)

Katzenauge W. Quarz-agathe chatoyant H.

It is of various shades of grey, green, brown, or red; and it
exhibits a peculiar play of light, resembling the eye of the cat,[*]
emphatically termed by the French, chatoyant, owing to the DXL (28
fibrous texture of the substance, arising, as is manifest in some rough specimens, from its consisting of amianthus or asbestus, enclosed in quartz. It is generally translucent; scratches quartz, and is infusible. Its specific gravity is about 2.7. It is composed, according to Klaproth, of 95 parts of silex, 1.75 of alumine, 1.5 of lime, and 0.25 of oxide of iron. Amianthus includes small proportions of alumine and lime. It is frequently employed as a precious stone, and is in considerable estimation.

This mineral is generally brought in the polished state from the coast of Malabar, and from Ceylon; but nothing is known of its geological situation.

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[*] Whence its name.

OPAL.*

Opal W. Quarz resinite H. Silex Opale Bt.

Opal, like quartz, consists chiefly of silex and water, but analysis shews that it generally contains a greater quantity of the latter than quartz: but having sometimes a resinous lustre, is probably the cause of its being termed by Haüy, Quarz resinite. None of its varieties are sufficiently hard to give fire with the steel.

1. PRECIOUS OPAL. NOBLE OPAL.

Edler Opal W. Quarz resinite opalin H. Silex opale Bt.

This beautiful mineral is of a white, bluish or yellowish-white colour: when viewed by transmitted light it is yellowish; it exhibits brilliant and changeable reflections of green, blue, yellow, and red. This play of colours has not been satisfactorily accounted for; by some it is supposed to be owing to the refraction and reflection of light in the numerous fissures of the stone. It is translucent: its fracture is conchoidal, with a vitreous or resinous lustre; it is easily broken, but scratches glass. Its specific gravity according to Brisson is 2.110. Before the blowpipe it decrepitates, and loses its colours. The Hungarian consists according to Klaproth of 90 parts of silex, and 10 of water: this water however is supposed by Berzelius (in common with the water found in other siliceous minerals) to be purely hygrometric, and therefore, to vary with the state of the atmosphere.

It occurs in abundance, accompanied by common opal, in a vein of clay porphyry traversing primitive rocks, at Czerwenitza in Hungary; in trap rocks in the Faroe islands; at Freyberg in Saxony, and in South America, whence it has lately been brought in specimens of considerable size and of great splendour, but very brittle.

2. FIRE OPAL.

Quarz resinite girasol H. Silex girasol Bt.

The fire-opal is found with the noble opal, in Hungary, but is said to be much scarcer. It differs from the precious, in possessing only a red reflection when turned towards the sun or a strong light.

From Cornwall I possess a specimen, raised about forty years ago from High Rosewarne Copper mine, which was in killas.

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* From the Greek signifying the eye; from the ancient belief in its power of strengthening the eye.

The fire-opal described by Jameson as having been brought only from Mexico, was transparent, of a hyacinth red, and shewed a carmine red and apple green irridescence. Girasol of a sky blue colour, has lately been found in Mexico imbedded in porcelain earth, with all the other varieties of opal.

3. COMMON OPAL.

Gemeiner opal W. Quarz resinite commun H. Silex resinite Bt.

Common opal is of various shades of white, green, yellow, and red, but is entirely without the play of colours belonging to the noble opal. In hardness, translucency, fracture, and specific gravity it is about the same. By one analysis, that of Ximapan CCCLXX in Peru consists of 92 silex, 7.75 water, and 0.25 oxide of iron. (29

It occurs with the noble opal in Hungary in primitive rocks; with galena and blende, in Saxony, Bohemia, and the Isle of Elba, in veins traversing primitive rocks. It occurs also in France, Poland, Italy, Hungary, Mexico, and near Easton on the banks of the Delaware in Pennsylvania.

From Cornwall, I possess several specimens, some of which are on a gangue of ochreous quartz and yellow copper, from High Rosewarne mine. It has also been found of a yellow colour, and possessing a play of red light, in Huel Spinster, near St. Day, in Cornwall. It occurs in the north of Ireland.

4. SEMI-OPAL.

Halb-opal W. Quarz resinite Hydrophane, H?

Semi-opal is generally much more opaque than common opal: occasionally however it is partially transparent, the translucent parts passing insensibly into the more opaque, or quite opaque, apparently by decomposition: the latter often absorbs water CXI. (3 greedily, and resembles porcelain clay. Some varieties become more transparent by immersion in water. It occurs of various shades of white, grey, yellow, brown and green. When compact, the fracture is flat conchoidal; the fragments are sometimes translucent on the edges. According to Klaproth, it consists of 85 per cent. of silex, 1 of carbon, 1.75 of oxide of iron, 8 of ammoniacal water, and a small portion of bitumen.

It occurs in most countries of Europe, especially in silver veins traversing granite and gneiss. It also occurs in amygdaloid, in the Faroe Isles, Greenland, Iceland, &c.: in serpentine in the Bare hills near Baltimore, and in granite near the falls of Delaware, in North America.

In the Isle of Rum, one of the Hebrides, it is found in amygdaloid; it also occurs in Scotland. In Cornwall, occasionally in the copper veins of that country, both translucent and opaque: it has occurred in Polgine and Huel Damsel and Rosewarne mines, associated with common opal, and lately in Treskerby mine near St. Day, with native copper.

5. WOOD-OPAL.

Holzopal W. Quarz resinite xyloïde H.

This variety is remarkable for its wood-like appearance, and is sufficiently distinguished from Wood-stone (wood petrified by chert, &c.) by its superior lightness, and greater translucency, as well as by its admitting of a conchoidal fracture. It occurs of several tints of white, grey, brown and black. In fracture, translucency, and lustre, it does not materially differ from semi-opal, but is generally harder.

It occurs in alluvium in Hungary, and in flœtz trap rocks in Transylvania.

6. FERRUGINOUS OPAL.

Opal-jasper, W. Jaspe-opal Br. Jasper opal J.

This mineral appears to be distinguished from common opal by its colours, which are various shades of red, yellow, and grey, which are generally deep, and by its being opake, or only feebly translucent on the edges. Its fracture is flat conchoidal. It does not become white before the blowpipe. A variety from Telkebanya consisted according to Klaproth, of silex 43.5, oxide of iron 47, water 7.5.

It occurs in porphyry near Telkebanya and Tokay in Hungary; in the Saxon Erzegebirge, near Constantinople, and in Siberia.

HYDROPHANE.

Quarz resinite hydrophane H. Silex hydrophane Bt.

This mineral possesses the property of becoming considerably transparent in water,* and of exhibiting some of the colours observable in the precious opal. It is commonly opake and is undoubtedly porous: it frequently adheres to the tongue. It consists, according to Klaproth, of 93.125 silex, 1.625 alumine, 5.025 water and inflammable matter. It is commonly considered to be a variety of opal.

It is chiefly found in Saxony, and in Hungary. At Mussinet near Turin, it occurs in veins of chalcedony, and of hard serpentine, traversing a serpentine mountain in every direction.

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* Whence its name, from the Greek.

MENILITE.

Quarz resinite subluisant, brunatre H. Silex menilite Bt.

The Menilite is by some considered a variety of semi-opal. Its common colour is a smoke brown : its structure is slaty ; it is somewhat translucent, and is found in irregular masses in beds of adhesive slate, between beds of sulphate of lime at Menil-montant* near Paris. From the resemblance of some of its darker varieties to pitch, it is sometimes called the *Pitchstone of Menil-montant*. It consists, according Klaproth, of 85.5 parts of silex, 1 of alumine, 11 of water and inflammable matter, with small portions of lime and oxide of iron.

A grey variety has been found at Argenteuil near Paris imbedded in a clayey marl, and in gypsum alternating therewith. It has also occurred at St. Ouen near Paris, and on the Maase.

FLINT.

Feurstein W. Quarz agathe pyromaque H. Silex pyromaque Bt.
La pierre à feu Br.

Flint is of various shades of grey, yellow and black. It is somewhat harder than common quartz, which it scratches : it is rarely laminated, and therefore may be broken with nearly equal
ease in every direction ; it is brittle when first taken from the CCCLX
native bed, but becomes harder by exposure. It has a perfectly conchoidal fracture, and feeble lustre ; thin fragments of the black varieties are very translucent, and sharp. Its specific gravity according to Brisson is 2.594. It consists according to Klaproth of 98 parts of silex, 0.5 of lime, 0.25 of alumine, 0.25
of oxide of iron, and 1 of water. It is infusible, but whitens CCCCIX
and becomes opaque.

The true native place of the Flint is the upper bed of the Chalk formation, where it occurs in regular beds consisting
either of nodules, or flat tabular masses, which may be seen of LXXXX
two miles in length in the chalk east of Dover. It is also plentifully found in alluvial deposites in the neighbourhood of chalk. Flint is often found enclosing or in the form of sponges,
alcyonia, echinites, &c. and Kirwan quotes from Schneider's XCII
Topog. Mineral., that 126 silver coins were found enclosed in flints at Grinoc in Denmark, and an iron nail at Potsdam?
By exposure to the action of air and water it becomes of a yel- CCXX
low colour, and is then termed *Ferruginous flint* : such for
the most part are the flints of our gravel beds, which have been CCXV
rounded by attrition.

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* Whence Menilite. CCL

CHALCEDONY.*

Kalzedon W. Quarz agathe calcedoine H. Calcedoine Br. Silex calcedoine Bt.

The term chalcedony now includes several varieties of mine-
CCIX (38) rals, agreeing in their general characters, and varying princi-
pally in colour.

It is found of various shades of white, grey, yellow, brown,
CCX (39) green, and blue; and the colour is for the most part uniform.
It occurs massive; forming veins; in nodules; and also botry-
oidal and stalactitical; sometimes it bears the impression of
CCVII (40) organized bodies; it never occurs crystallized, but is frequently
met with coating crystals of quartz, and occasionally in cubes
CCVIII (41) which, it is ascertained, are only secondary, or *pseudomor-
phous crystals.* It is commonly semi-transparent; it has an
even fracture, sometimes flat-conchoidal, and is harder than
flint. The specific gravity of chalcedony is about 2.6. It is
infusible. The chalcedony of Faroe yielded by the analysis
of Bergman, 84 of silex and 16 of alumine.

In Asia, it is found in Ceylon; in traps in Dauria; in the Altaic and Uralian mountains, &c. In Africa, on the banks of the Nile, and near Thebes. In several places in North America, and most of the countries of Europe.

In England. Perhaps the finest stalactitical specimens in the world were found in Trevascus mine in Cornwall, others were botryoidal: chalcedony also occurred in the neighbouring mine Huel Alfred: and in blue stalactites, very greedy of water, in Peduandræ mine, and botryoidal enclosing chlorophane: massive, and enclosing copper, and very nearly allied in appearance to flint in Relistian mine: partially or wholly filling shells on Black Down, Devonshire. It occurs in nodules in the toadstone of Derbyshire, and the basalt of the north of England. In Scotland, in the trap rocks of Fifeshire, of the Pentland hills near Edinburgh, of West Lothian and several other counties: in the same kind of rock in the Isles of Mull, Rum, Sky, Egg, and Canna.

It is however probable that some of the above localities belong rather to that variety of chalcedony which is termed agate.

The following substances are considered to be varieties of chalcedony.

Onyx.† Quarz agathe onyx H. Six onyx Bt. Onyx consists of alternate layers of brown and opaque white chalcedony;

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* So named from the town of Calcedon in Upper Asia, where it was collected by the ancients.

† According to Brongniart "*onyx* veut-dire *ongle*" (the nail); inferring that this stone received its name from the two colours sometimes observable on the human nail.

sometimes the stone is cut into portions of about the size of a bean, so as to leave opaque white circles, resembling the iris of the eye: these are termed *onyx-eyes.*

Sard.[*] Quarz agathe Sardoine H. Silex Sardoine Bt. Consists of chalcedony of a deep rich reddish brown colour, by transmitted light approaching to blood red. It is however a term used principally among jewellers.

Sardonyx consists of sard, and alternate layers of onyx,[†] or milk white chalcedony.

Plasma[‡] resembles chalcedony, in being translucent, and somewhat harder than quartz. It is of a dullish green colour, with yellow and whitish dots, and has a glistening lustre. It has not been analyzed. Plasma is brought from Italy and the Levant; and is said to occur at Taltsa, in High Hungary; also disseminated in rounded pieces, with flint and hornblende, in a mountain of serpentine, at Bojanowitz, in Moravia. Its specific gravity is 2.04. Dr. Mac Culloch is of opinion that the colour of plasma is owing to the equal distribution of chlorite through the mass of chalcedony.

Heliotrope[‖] is mostly of a deep green colour, and translucent; and commonly, yellow or blood-red spots are interspersed through the substance. From the latter circumstance it has obtained the name of *Bloodstone.* It is considered to consist of chalcedony coloured by chlorite, or by green earth; and is found in Siberia, Iceland, and in a vein at Jaschkenberg, in Bohemia,—but the most beautiful varieties are brought from the east; whence, among lapidaries, by whom it is in considerable request, it has obtained the name of *Oriental jasper.* The specific gravity of heliotrope is 2.6. It has of late years been found by Dr. Mac Culloch in the Isle of Rum: but it rarely includes the red spots: he considers the colouring matter of this mineral to be the same as that of plasma: he also found it in the hill of Kinnoul.

Chrysoprase[§] is of an apple-green colour, translucent, massive, internally somewhat glimmering, or not quite dull, and its fracture is even, rarely approaching the conchoidal. It is not so hard as chalcedony. Its specific gravity is 3.25. Before the blowpipe it loses its colour, becomes opaque, but is infusible without addition. According to Klaproth, it consists of silex 96.16, lime 0.83, magnesia 0.08, alumine 0.08, oxide of iron 0.08, oxide of nickel 1.00. The oxide of nickel is supposed to give its colour. The very minute quantities of lime and magnesia included in this mineral, do not forbid its being ranked with varieties of chalcedony, to which its general characters determine it to belong.

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[*] It is said that the best is found in Sardinia, whence Sard.

[†] Whence Sardonyx.

[‡] Plasma, Greek; engraving; the stone having been used by the ancients for that purpose.

[‖] From two Greek words, signifying spotted as with suns.

[§] From the Greek, signifying a superior kind of prase.

It has been found only at Kosemutz in Silesia, in veins traversing serpentine, and accompanied by chalcedony, opal, quartz and the pimelite.

It is much prized by jewellers, and is usually cut into a convex form, termed by jewellers *en cabochon*.

1. CACHOLONG.

Quarz agathe cacholong H. Silex cacholong Bt.

This mineral is opaque, harder than opal, dull externally, but internally of a somewhat pearly lustre; it is brittle and its fracture is flat conchoidal: it sometimes disintegrates by exposure, when it adheres to the tongue: it is of a milk, yellowish or greyish white. It is infusible before the blowpipe. Its specific gravity is about 2.2.

It occurs in loose masses on the borders of the River Cach* in Bucharia, in masses composed of alternate layers of chalcedony and cacholong. It occurs with chalcedony in the trap rocks of Iceland; in the Faroe Islands, and in Greenland. It is said also to occur in Carinthia, the isle of Elba, and at Estremadura in Spain.

2. CARNELIAN.†

Karneol W. Quarz agathe cornaline H. La cornaline Br. Silex cornaline Bt.

The finest specimens are brought from Cambay and Surat in India. Carnelian is also procured near Broach in the province of Guzera, Hindostan, during the dry season, in the channels of torrents; and is then of a blackish olive passing into grey; and in the form of nodules. These are first exposed to the sun for some weeks, and then placed in earthen pots and subjected to heat, which gives them the colours which constitute their

LXV (43)

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* Whence its name of Cacholong.

† From the resemblance of its colour to that of flesh.

value in jewellery. Carnelians are also found in rounded pieces in Arabia, Surinam, Siberia, and Sardinia, Bohemia, Saxony, and the Palatinate.

Carnelian as used in jewellery is white, yellow, brown, or red, of various shades. It is softer than common chalcedony, and has a conchoidal fracture. According to Bindheim, it consists of silex 94, alumine 3.50, iron 0.75, but according to Tromsdorff, of 99 parts of silex.

3. AGATE.*

Quarz agathe H.

Agate is not a simple mineral, but for the most part a compound of several siliceous minerals; chalcedony however generally appears to form the basis; it mostly prevails over the other ingredients, which consist of amethyst, quartz, carnelian ?, jasper, heliotrope, and opal; and some varieties are constituted chiefly of chalcedony. DXIV(4

Ribbon agate consists of layers of chalcedony, amethyst, jasper, quartz, and hornstone? alternating with each other, and always parallel. It occurs in gneiss in Saxony; other veins occur in porphyry. CLX (4

Brecciated agate. This most beautiful agate consists of fragments of ribbon agate united by a basis of amethyst, and occurs in the middle of one of the Saxon veins. LXXXIII (4

Fortification agate. This occurs in irregular nodules, commonly in amygdaloid, as in that of Scotland (*Scotch pebble*) but chiefly in that of Oberstein on the Rhine. When cut and polished, the surface much resembles a fortification; the center often consisting of amethyst, with jasper, quartz, and chalcedony surrounding it.

Mocha-stone. When translucent, agate contains appearances of aborization, or vegetable filaments, but which have been supposed to be owing to the infiltration of iron or manganese through its natural crevices, and is termed *Mocha-stone.* This is believed chiefly to be brought from Mocha in Arabia.

Some of these vegetable appearances are by several late acute observes, believed to be cryptogamous plants coated by some mineral oxide.

Moss agate. This beautiful agate consists chiefly of chalcedony, which sometimes contains irregular veins of red jasper, together with the appearance of vegetable ramifications of various shades of green, red, brown, and black: sometimes it is without the jasper.

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* From the river Achate?

Dr. Mac Culloch has instituted a very ingenious inquiry into the nature of those vegetable appearances of different colours visible in the more transparent chalcedonies, which are termed mocha, and more particularly in those which are less so, termed agate. Close observation, added to chemical experiment, induced the conclusion than many of these appearances are owing to the existence in the stone of aquatic confervæ; that these plants sometimes appear perfectly in their natural form and colour: in others they seem to be coated by oxide of iron, which occasionally hides the form of the plant and discolours it. Mosses and some varieties of the lichen have been observed; and occasionally chlorite, which sometimes is so disposed as to represent a vegetable. A crysalis, probably of a moth? was observed in an onyx agate, in a ring in the possession of Earl Powis.

The most beautiful agates are found in the trap rocks of Oberstein; some are hollow, and are lined with crystals of amethyst, others also include harmotome. Agate is also found in Saxony, Bohemia, Silesia, Italy, Siberia, and India, and in Virginia and Maryland, in North America. Also in South America.

Nodules of agate in a decomposing state occur in the gravel near Lichfield; in the trap rock called the Old Rock, of Micklewood in Gloucestershire, and veins of agate occur in the serpentine of Kynan's Cove, Cornwall.

Agate pebbles of a grey colour occur at Dunvegan in the Isle of Sky. In the interior of some that were hollow, (geodes) Dr. Mac Culloch found quartz crystals, on which were sprinkled crystals of stilbite, chabasie, and filamentous mesotype. Nodules of it sometimes occur in trap in the hill of Kinnoul.

Agate geodes occur in the basalt of the Giant's Causeway.

JASPER.

Jaspis W. Jaspe H.

The minerals comprehended under the term Jasper, are for the most part readily distinguished from Agate, by their almost perfect opacity.

I. COMMON JASPER.

Gemeiner Jaspis W. Quarz Jaspe H. Jaspe Commun Br. Bt.

CXVIII The most common colours of this mineral are yellow, brown,
(46) and red of various shades, and sometimes green; occasionally

intermixed, or in spots and irregular veins. It has often a resinous lustre, but is sometimes dull. Its fragments are rarely translucent on the edges. It is hard, and frequently brittle. It is infusible before the blowpipe. Its specific gravity is about 2.5. It does not certainly appear to have been analysed: but Kirwan found in one variety of jasper 75 of silex, 0.5 of alumine, 00.2 of lime, and 13 of iron.

It has been observed in most countries on the Continent of Europe, and occurs in veins and beds in primitive and secondary mountains.

In Cornwall it occurs with compact brown ironstone and brown hæmatites, near Botallack; in small quantity, with red copper, in Tin Croft mine, near Redruth. In Scotland, according to Jameson, it occurs in the Pentland and Moorfoot hills near Edinburgh; in transition rocks on the borders of the Tweed and the Clyde: in traps and transition rocks in Ayrshire and Dumfries-shire: north of the Firth of Forth; and in several of the Hebrides.

2. STRIPED JASPER. RIBBON JASPER.

Band Jaspis W. Quarz Jaspe Onyx H. Le Jaspe rubane Br. Bt.

CLVII (4

Its colours are green, yellow, and red, of various shades, rarely blue. These colours are displayed occasionally in spots, commonly in stripes. It is massive, has a flat conchoidal fracture, is opaque, even on the edges of its fragments. The most beautiful variety is composed of equal and parallel layers of the foregoing colours.

It occurs in the southern part of the Uralian mountains in Siberia: and in the Hartz, with flinty slate in a secondary rock: in clay porphyry in Saxony, but the colours are less various and beautiful.

It occurs, according to Jameson, in the Pentland hills near Edinburgh, in clay-porphyry, but the colours are not varied or fine.

3. EGYPTIAN JASPER. EGYPTIAN PEBBLE.

Egyptischer Jaspis W. Quarz agathe onyx opaque H. Jaspe Egyptien. Br. Bt.

It occurs in roundish masses which are externally rough, and generally of a brown colour. Internally it is usually of a light colour, which sometimes approaches to that of cream, around which are disposed irregular zones or bands of various shades of brown, sometimes intermixed with nearly black spots, and also with dentritic appearances. Its specific gravity is 2.5—

2.6; in hardness it equals quartz, and is infusible. By analysis of Weiglib, which does not seem to have been complete, it yielded 75 parts of silex, 15 of alumine, and 5 of magnesia.

It is found, according to Dr. Clarke, in vast abundance, together with masses and detached fragments of petrified wood, among which are several varieties of the palm, scattered over the surface of the sandy desert, eastward of Grand Cairo, even to the borders of the Red Sea.

4. PORCELAIN JASPER. PORCELLANITE.

Porzellan Jaspis W. Jaspe Porcellanite Bt. Jaspe Porcellaine Br.

Porcellanite is found massive, sometimes of a slaty structure. Its colour varies from grey to bluish-grey, mixed with red; ochre yellow; greyish or bluish-black. Its fracture is conchoidal. It is opaque, has a glimmering lustre, and is hard enough to scratch glass. It is not abundant; being principally if not exclusively found in places in which mines of coal have been in a state of combustion; and is regarded as shale altered by heat. It melts into a semitransparent enamel. At Mount Brussant, near St. Etienne, in France, it is composed of layers, alternately grey and red; that of Schlangenberg, in Bohemia, is of a dull green colour.

It is found near Madely in Shropshire, and Dudley in Worcestershire.

5. AGATE JASPER.

Agate Jaspis W.

Its colour is very pale yellowish or reddish white, or reddish: several colours generally occur together, irregularly arranged. It is dull, massive, opaque and light; it rarely adheres to the tongue: its fracture is small and imperfectly conchoidal.

It occurs in layers in agate balls, in amygdaloid, as in those of the central parts of Scotland: also in Saxony, Deux-ponts, and Hungary.

6. RUIN-JASPER.

This substance is generally of a brownish tint, and when cut and polished exhibits appearances resembling delineations of ruined buildings. It is commonly known by the name of *Ruin Agate*, but its opacity, which is perfect or nearly so, evinces that it ought to be classed with jaspers.

HORNSTONE.

Hornstein W. Quarz agathe grossier H.

This substance occurs massive, in nodules, also pseudomorphous; the massive has a splintery or somewhat conchoidal fracture, and is translucent, or opaque; it is dull, or has a glimmering lustre; it is scarcely so hard as quartz, and is infusible. Its general colour is grey, which is tinged blue, green, brown, red or yellow. Analysis of a soft hornstone of a green colour used for the setting of lancets, &c. by M. Faraday, silex 71.3. alumine 15.3. protoxide of iron, 9.3. and a trace of lime. It is difficult if not impossible at once to distinguish hornstone from compact felspar; hornstone is infusible; felspar is fusible.

Hornstone is described as occurring in round masses in limestone, as in Bavaria; and sometimes as forming the basis of porphyry, as in Sweden at Dannemora and Garbenburg; and in several countries of the European continent.

It occurs as the basis of porphyry in Perthshire, Argyleshire, &c. in Scotland, and in the Shetland islands.

Pseudomorphous Hornstone occurs in six-sided prisms, sometimes terminated by three planes, in rhomboids and other forms belonging to calcareous spar. CCCCLXX

Woodstone. It consists of wood, of which sometimes the fibrous appearance is preserved, petrified by hornstone.

It is found in several European countries in sandy or alluvial soils.

In England it occurs abundantly in ferruginous sand near Woburn in Bedfordshire; also near Nutfield in Surrey. CLXIII (

Chert occurs massive; it has a flat conchoidal fracture, and mostly a somewhat waxy lustre; its colours are various.

It occurs abundantly in beds in the green sand at the CLXIV
Undercliff at the Isle of Wight: in the same sand near
Folkstone, and in Devonshire: plentifully in Derbyshire CCCCLIX
in nodules and layers in the carboniferous or mountain
limestone, parallel with its stratification. CCXCI (

LEELITE.[*] CCXCII (

This substance was first noticed publicly by Dr. Clarke of CCXCII
Cambridge, in the Annals of Philosophy for 1818. It is
there described as a red siliceous stone found at Gryphytta in
Westmania, which had been noticed by some Swedish mineralo-

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[*] In honour of J. F. Lee, LL.D. of St. John's College, Cambridge.

gists as a pure hydrate of silica, of the nature of opal. It possesses about the same lustre and translucency as horn. The fracture is described as being rather splintery than conchoidal, and resembling that of flint. Its specific gravity is 2.71.

It consists according to Dr. Clarke of silex 75, alumine 22, manganese 2.50, water 0.50.

SILICEOUS SINTER.

Kieselsinter W. Quarz agathe concretionnée thermogène H.

The common colours of this mineral are white, greyish-white, grey, and yellowish grey. It is light, brittle, dull, commonly porous, with a fibrous texture, but sometimes compact enough to admit of a conchoidal fracture, with a somewhat pearly lustre. Its specific gravity is about 1.807. It is infusible without addition before the blowpipe; and consists according to Klaproth of 98 parts of silex, 1.5 of alumine, and 0.5 of iron.

It occurs abundantly around, and is deposited by, the hot springs of Iceland.

Opaline siliceous sinter is whitish, with brownish, blackish, or bluish spots. Its fragments shew dendritic appearances. It has a glistening lustre, and imperfectly conchoidal fracture; is translucent on the edges, brittle, and adheres to the tongue. It somewhat resembles opal.

Pearl sinter, or *Fiorite*, occurs in stalactitical, cylindrical, botryoidal, and globular masses, of a white, yellowish white, or greyish colour: externally it is smooth and shining, internally it is glistening, with a lustre between pearly and resinous; the fracture is fine grained and flat conchoidal; it is translucent on the edges, not so hard as quartz, and is infusible before the blowpipe without addition. It is composed of 95 parts of silex with 2 of alumine and 2 of lime. It was first discovered, as I am informed by Dr. Somerville, by Professor Santi of Pisa, who published an account of it in the 'Viaggia al Amiatta:' he found it on the mountain Amiatta, not at Santa Fiora, which is a castle several miles distant. It has since been found on volcanic tufa and pumice in the Vicentine. It is considered to be a volcanic production.

CLXVIII
(4)

KARPHOLITE or CARPHOLITE.

The colour of this mineral is generally yellow,[*] but it is sometimes nearly colourless. In occurs in minute fibrous crystals, generally in a radiating form; also amorphous, when it is white; and in an earthy state, probably from disintegration. It is commonly translucent, with a glistening and almost pearly lustre, and it is very brittle. Specific gravity 2.935. Analysis of the amorphous by Professor Steinmann, silex 37.53, alumine 26.47, oxide of manganese 18.33, protoxide of iron 6.27, water 11.36. Under the blowpipe on charcoal it intumesces, whitens, and fuses slowly into a brown opaque glass; with borax into a transparent glass.

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[*] Its name was given from its straw-yellow colour.

It is found at Schlackenwalde in Bohemia.

ECXIV
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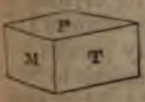
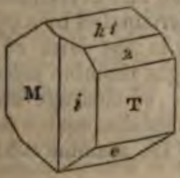
TABULAR SPAR.*

Schaalstein W. Spath en Tables H.

The tabular spar is of a greyish, yellowish, greenish, or reddish white colour, and of a shining and somewhat pearly lustre; sometimes translucent and hard, more often friable. It is phosphorescent when scratched with a knife. That of Dognaska, as well as that included in the cinnamon stone, is mechanically divisible into prisms of 95°. 20′ & 84°. 40′ by the reflective goniometer, and parallel to one of the diagonals; appearances of natural joints oblique to the axis of the prism, are visible. The following figure and measurements prove the primary form to be a doubly oblique prism, but the inclination of the terminal on the lateral planes, has not yet been ascertained. Its specific gravity is 2.86. It is composed of 50 parts of silex, 45 of lime, and 5 of water, according to Klaproth. Analysis of that of Pargas in Finland, by M. Bonsdorff, silex 52.58, lime 44.45, magnesia 0.68, alumine a trace, protoxide of iron 1.13, volatile matter 0.99.; it differs from the preceding in containing no water. A fragment placed in nitric acid effervesces quickly at first, and then falls into powder. On charcoal it melts on the edge into a semi-transparent colourless glass globule, but requires a very strong heat for its perfect fusion; with borax it fuses easily into a transparent glass.

Primary Form.





M on T	95°.20′
M on i	139. 45
T on i	135. 30
M on h1	93. 40
T on h1	126. —
h1 on h2	156. 30
e on h1 return	94. 15

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* From its (occasional) occurrence in tabular crystals.

This mineral has been found at Oravitza, and at Dognaska and Sastra in the Bannat of Temeswar, entering into the composition of a rock, consisting principally of bluish carbonate of lime and olive-coloured garnets; or, according to others, in a vein of bluish lamellar carbonate of lime, containing green garnets: more lately, in masses of the cinnamon-stone from Ceylon; with colophonite in N. America; and many specimens heretofore considered to be tremolite from the Bannat, have lately been proved to be tabular spar. It has also been found at Dannemora in Sweden.

JEFFERSONITE.*

Keating.

This mineral is described as occurring in crystalline masses of a dark olive green colour passing into brown, translucent on the edges, and as yielding to mechanical division in several directions, which appear to be incompatible with each other, and are not given with sufficient precision to decide its primary form. On the planes of cleavage the lustre is described as being semi metallic, on the cross-fracture resinous. Specific gravity 3.51—3.55; hardness between fluor and apatite; analysis, silex 56.0, lime 15.1, alumine 02.0, protoxide of mannanese 13.5, peroxide of iron 10.0, oxide of zinc 01.0, loss 02.

It has been found in masses, the largest of which does not exceed the size of a pigeon's egg, imbedded in franklinite and garnet, at the Franklin iron works, about six miles north east of Sparta in Sussex county, New Jersey, North America.

LIEVRITE. † YENITE.

XXIX Yenite H. Lievrite J.

(6) The Lievrite is of a brown, or brownish black colour, sometimes dull externally, but the crystals are often brilliant, and
LXXIX opaque; it scratches glass, but is scratched by adularia. It
(7) occurs amorphous, acicular, and also crystallized, generally in the form of a rhombic prism, terminated by a pyramid: several varieties have been discovered in the form of its crystals, of which the primary form is a right rhombic prism of about 111° 30′ and 68° 30′, which allows of cleavage only parallel to a plane passing through its longer diagonal. Analysis by Stromeyer, silex 29.278, lime 13.779, alumine 0.614, black oxide

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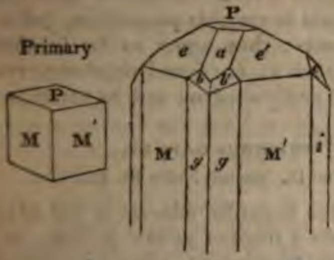
* Jeffersonite in honor of Jefferson, President of the United States.

† Lievrite in honour of Le Lievre; Yenite in commemoration of the battle of Jena.

manganese 1.587, water 1.268; and therefore does not seem to belong to earthy minerals; but it is mostly ranked in that class. Its specific gravity is 3.8. On charcoal it fuses readily into a black globule, which attracts the magnet if not heated to redness; with borax readily into a dark and almost opaque glass.



M on M′	111°.30′
P on M or M′	90
M on *g* or M′ on *g*	164. 35
M on *i*	160. 48
g on *g*	151. 42
M on *e* or M′ on *e*′	128. 50
P on *e* or *e*′	141. 48
e on *e*′	139. 30
a on *e* or *e*	160. 30
P on *a*	146. 30
P on *c*	137. 45
c on *e*′	144. 25
b on *e* or *b*′ on *e*′	161. 20

It has been found only in Elba, at Rio la Marina and Cape Calmite; it is dispersed in crystals and almost compact round masses, in a thick bed of a blackish-green augite; and is accompanied by yellowish-green epidote, quartz, and arsenical iron. The bed containing the yenite lies upon another, consisting of large grained carbonate of lime, enclosing talc. At Cape Calmite it is accompanied by magnetic iron ore, granite, and quartz.

It is said to have been found in Siberia, but has certainly been discovered in Brodgang mine, Fossum, Norway.

BRONZITE.

Bronzit, Karsten. Var. de Diallage Metalloïde H.

The colour of this mineral is brown; it has a pseudo-metallic lustre, frequently approaching that of bronze;* its structure is lamellar with joints parallel to the lateral (and apparently also to the diagonal) planes of a rhombic prism of 100° and 80° by the reflective goniometer; this mineral yields readily to mechanical division, and has frequently thin layers of calcareous spar between the laminæ; the fragments are streaked on the surface; it is opaque when in mass, but when reduced to very thin laminæ they appear, by the assistance of a lens and a strong light, of a green colour in one direction, translucent and nearly colourless in the other. It consists of 60 per cent. of silex, 27.5 of magnesia, 10.5 of oxide of iron, and 0,5 of water.

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* Whence Bronzite.

It is found in large masses in beds of serpentine, near Kraubat, in Upper Stiria; and according to Jameson, in a syenitic rock in Glen Tilt in Perthshire, Scotland.

GARNET.*

Under this term are included several substances consisting principally of the same elements in variable proportion, but several include other constituents; they agree so far in their external characters, that all such as are found regularly crystallized, occur in the rhombic dodecahedron and its varieties.

1. ALMANDINE. PRECIOUS GARNET.

Edler Granat W. Grenat H. Grenat Noble Br. Bt.

The principal colour of this beautiful mineral is red of va-
CLXIV rious shades, having sometimes a tinge of yellow or blue, or a
(55) smoky aspect: it is commonly translucent, often transparent.
It occurs crystallized in the rhombic dodecahedron, and
some varieties may be cleaved, though not without difficulty,
parallel to its planes; it is therefore considered to be the pri-
XX (56 mary form of its crystals; the cross fracture is commonly con-
choidal and with a shining, vitreous lustre. It is hard enough
to scratch quartz. Its specific gravity is 4.3, and it is fusible
into a black enamel. According to Klaproth it consists of 35.75
parts of silex, 27.25 of alumine, 36 of oxide of iron, and 0.25
of oxide of manganese. Before the blowpipe it fuses alone
into a black globule, with borax slowly into a dark glass
tinged by iron.

It occurs in primitive rocks, most commonly in mica slate; but is also found in alluvial deposits.

The alamandine is very much esteemed as a precious stone. The most beautiful, which are sometimes of reddish violet colour, are brought from Sirian, the capital of Pegu: among lapidaries, they are improperly called Syrian garnets. They appear to be the *Carbuncle* of the ancients. Of their geological situation in Pegu, we are entirely ignorant. They are also found in Bohemia, Hungary, Piedmont, and several other European countries, and in Ethiopia, Madagascar, Brazil, and Mexico.

In Bohemia, they are found near Meronitz and Trziblitz, in the circle of Leutmeritz, disseminated in an alluvial deposite, consisting principally of fragments of serpentine and rounded masses of basalt, cemented by a grey marle. In this deposite are also found hyacinths, beryls, sapphires, quartz, magnetic iron, and even fossil shells.

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* Grenat, Fr.; of the colour of pomegranate seeds.

It is said to have been met with in granite at Strontian in Scotland; at Ely, in Fifeshire; in several of the Hebrides and in the Shetland islands; also in Wicklow, in Ireland.

2. COMMON GARNET.

Gemeiner Granat W. Grenat Brun, &c. H. Grenat Commun, Br. Bt. XLIII (57)

The common garnet is of a reddish, yellowish, greenish, or blackish brown colour, and differs from the precious garnet, in being commonly opaque, or only translucent: it is found in small granular masses, and crystallized in the form of its primary crystal the dodecahedron with rhombic planes, which often is considerably modified. It is harder than quartz, but not so hard as the almandine. Its fracture is sometimes uneven, sometimes lamellar. It consists according to Vauquelin, of 43 parts of silex, 16 of alumine, 20 of lime, and 16 of oxide of iron: but according to Hisinger, there is no lime in the immense garnets of Fahlun. Most of the common garnets fuse alone before the blowpipe, into a blackish or greenish glass.

XLIV (58

CCCLXXII

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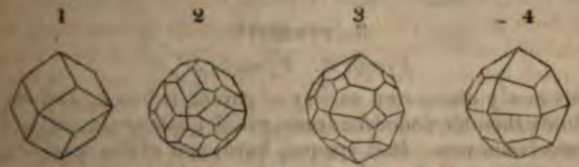
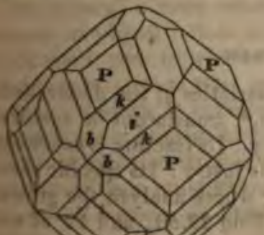


Fig. 1, Primary rhombic dodecahedron. Fig. 2. the same, of which all the edges are replaced by 6-sided planes; which, being further advanced in fig. 3, reduce those of the primary crystal to small rhombs: and being complete in fig. 4, assume the form of trapeziums, forming the trapezoidal garnet, on which no portion of the primitive planes is visible.



	Haüy.
P or P on P	120°
P on *i*	150°
P on *k*	160°.53′.36″
k or *k* on *i*	169. 6. 24
b or *b* on *i*	155. 54. 48

Common garnets are very abundant; they principally occur disseminated in some of the older rocks, as mica-slate, serpentine, and gneiss, and sometimes in granite. They are met with in most countries in which those rocks occur, and are often so plentiful as almost to constitute the mass. They are found also in mineral veins, accompanying some of the ores of copper, lead, magnetic iron, mispickel, &c. In the mountains separating Stiria and Carinthia, they are met with upwards of 2lbs. in weight, in a bed of green talc: the structure of these is often lamellar, and parallel with the planes of a rhombic dodecahedron. In Bohemia they are found of a brown colour, accompanying tin; in Siberia on the banks of the Wiloui, of a pale green, in lithomarga; at Topschau, in Hungary, of an emerald green, in serpentine: in Corsica, of a yellow colour; in the Grisons, &c. of an orange colour.

In Britain, they occur plentifully in Cornwall, at Botallack cliffs near the Land's end, in schist and chlorite (fig. 1.); north of Keswick in Cumberland, in a porphyritic felspar; in rocks near Huntly, Scotland; of considerable dimension and very perfect in the Isle of Mull. They are found in Wicklow, and Donegal counties in Ireland, imbedded in granite.

3. PYRENITE.

Pyrenit W. Pyreneite J.

This newly discovered variety of garnet is black, and occurs in minute rhombic dodecahedrons, which glisten externally. The fracture is uneven. It is opaque, hard, and of the specific gravity of 2.500. Before the blowpipe, it loses its colour, and melts easily into a porous black slag. According to Vauquelin it consists of silex 43, alumine 16, lime 20, oxide of iron 16, water and other volatile matters 0.4. It occurs imbedded in primitive limestone, in the Pic Eres-Lids near Barèges in France, in perfect, but minute crystals.

4. GROSSULAR.

This rare mineral occurs in the varieties of the dodecahedron common on the garnet; it is green,* translucent or semitransparent, hard, and brilliant externally. Its fracture is conchoidal, and its fragments possess a vitreous lustre: Its specific gravity is 3.372. according to Klaproth, by whose analysis the grossular consists of silex 44, alumine 8.50, lime 33.50, and 12 of oxide of iron.

It occurs, with vesuvian, in an argillaceous rock of a greenish grey colour, near the river Wiloui in Siberia.

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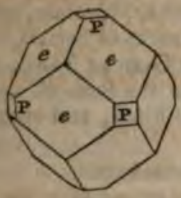
* Grossular, Fr. Gooseberry, from its green colour.

ƐLXXXII
(8)

5. APLOME.

Aplome H.

The Aplome is usually considered to be a variety of the garnet, with which it agrees in respect of its external figure, as well as its general aspect: but differs in this respect, viz. that although it commonly occurs in rhombic dodecahedrons, its planes are striated parallel with their lesser diagonal, which, in the opinion of Haüy, indicates its primitive not to be a rhombic dodecahedron, but a cube.* It is usually of a deep brown, or orange-brown colour, and is opaque, and somewhat harder than quartz. It consists according to Laugier, of 40 of silex, 20 of alumine, of 14.5 of lime, 14.5 of oxide of iron, and 2 of oxide of manganese. It is fusible into a black glass, and not like the common and precious garnet, into a black enamel.



P on P.... 90°
e on e ....120°
P on e....135°

The aplome is found on the banks of the river Lena in Siberia. Garnets of a yellowish-green colour have been met with at Swartzenburg, in Saxony, which have considerable affinity to this mineral.

6. MANGANESIAN GARNET.

Grenat Manganésié Bt.

This mineral occurs massive, and in dodecahedral crystals variously modified; it is a little translucent at the edges. It does not appear to possess any regular structure: its fracture is commonly vitreous and imperfectly conchoidal. Its colour is a deep hyacinth or brownish-red. It is fusible by the blowpipe, and, according to Klaproth, consists of silex 35, alumine 14, oxide of manganese 35, oxide of iron 14.

It occurs in granite near Aschaffenberg, in Franconia. In the United States, at Jones's Eddy, near Bath, it is found massive.

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* Whence Aplome, in allusion to the ready transition of the cube into the rhombic dodecahedron.

A mineral under the name of *Roltioffite* or *Rothoffite*, has has lately been brought from Longbanshytta in Sweden, which is considered to be a manganesian garnet; it is crystallised in dodecahedrons.

7. MELANITE.

Melanit W. Grenat noir H. Grenat Melanite Br. Bt.

The Melanite is usually black * or greyish black, and opaque, and occurs in the form of a rhombic dodecahedron, of which the edges are commonly replaced by planes, (see Colophonite opposite page). It consists of about 35 parts of silex, 6 of alumine, 32 of lime, 25 of oxide of iron, and a trace of oxide of manganese. Its specific gravity is 3.7.

Before the blowpipe it fuses alone into a brilliant black globule; with borax difficultly into a glass coloured by iron.

It has been found in Italy, at Frascati, near Vesuvius, in a volcanic rock, enclosing also felspar, idocrase, and hornblende: it also occurs in the calcareous rocks of Somma. It is described by Cleaveland as occurring at German Town, six miles from Philadelphia, in gneiss, and in the form of a polyedron with 24 trapezoidal faces, of a velvet black, and opaque. (See common Garnet, fig. 4.)

8. ALLOCHROITE.

Allochroit W. Allochroite H.

The Allochroite is of a greyish, dingy yellow, or reddish colour,‡ and opaque; it is not so hard as quartz, but gives fire with the steel. Its fracture is uneven, and it has a shining vitreo-resinous lustre. According to Vauquelin, it consists of 35 parts of silex, 8 of alumine, 30.5 of lime, 17 of oxide of iron, 3.5 of oxide of manganese, and 6 of carbonate of lime. Before the blowpipe it easily fuses alone into a brilliant black glass; with borax into a glass coloured green by iron.

The allochroite is found in the iron mine of Virums, near Drammen in Norway, accompanied by carbonate of lime, hematites iron, and brown garnets.

9. COLOPHONITE.

Grenat Resinite H.

This mineral is of a blackish or yellowish brown,† or of an orange-red colour; and is, both on the surface and when fractured, of a shining vitreous lustre. Its specific gravity is only

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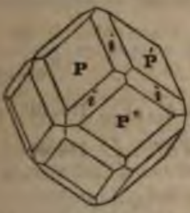
* Whence Melanite, from the Greek.

‡ Whence probably its name, from two Greek words signifying of various colours.

† Colophonite, from the Greek, signifying of a resin colour.

2.5. It is composed by the analysis of Simon, of 35 per cent. of silex, 15 of alumine, 29 of lime, 6.5 of magnesia, 7.5 of oxide of iron, 4.75 of oxide of manganese, and 0.5 of oxide of titanium.



P on P′ or P″ .... 120°
P, P′, or P″ on i.. 150

It is found near Pitigliano, in Italy, and in Norway.

10. PYROPE.[*]

Pyrop W. Grenat, rouge de feu, granuliforme H.

The Pyrope occurs in rounded or angular grains, of a red colour, which is sometimes clouded with yellow: it never is found crystallized. It is transparent, has a conchoidal fracture, and vitreous lustre; it scratches glass. Its specific gravity is about 3.8, and it is composed by the analysis of Klaproth, of 40 per cent. of silex, 28.5 of alumine, 3.5 of lime, 10 of magnesia, and 16.75 of oxide of iron and manganese. That of Ceylon before the blow-pipe fuses into a brilliant black glass; with borax into a chrome green glass.

The *Foliated Pyrope* of Greenland is of a deep blood red, lustre not adamantine, softer than pyrope. Specific gravity 3.634. Analysis by Pfaff, silex 41.82, alumine 17.82, magnesia 4.90, oxide of iron 32.42, oxide of manganese 3.12, lime 0.80.

Pyrope occurs imbedded in serpentine at Zoeblitz in Saxony, and in wacke, in Bohemia; but is more common in the latter country in alluvial deposites, accompanied by hyacinths and sapphires.

It is said to occur in Cumberland in clay-stone?

Pliny and Ovid mention a stone by the name of Pyrope, which is supposed to be nearly allied to this mineral.

11. TOPAZOLITE.[*]

Topazolite, Bonvoisin.

This variety of the garnet has been discovered within the last few years. It occurs in remarkably well-defined dodecahedral crystals, of a topaz yellow colour, either perfect, or, more commonly exhibiting a very low four-sided pyramid on each plane; it is translucent: it also occurs of an olive green. It consists of silex 37, alumine 2, lime 29, *glucine* 4, iron 25, manganese 2, Bonvoisin.

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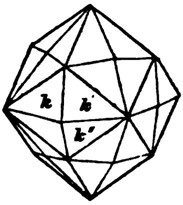
[*] From the Greek signifying a fire red colour.

[*] So named from its being nearly of a topaz yellow.



k on *k'* ...... 179.10'

k on *k''*...... 178.40

It has been found only at Mussa in Piedmont, sometimes upon mussite.

Succinite. Bonvoisin.

It is of an amber* yellow and translucent. It occurs in globular masses of the size of a pea; it is not hard enough to scratch glass, but easily pulverizes, and melts into a blackish glass under the blow-pipe. It is considered to be an amorphous variety of the topazolite.

It occurred in a serpentine rock in the valley called Viu, forming part of the great valley of Lans in Piedmont.

CINNAMON-STONE.

XXIII Kanelstein W. Essonite H.

(9) This mineral has been found in small splintery fragments, but commonly occurs in masses which are full of fissures; giving to it somewhat the appearance of being composed of small adhering grains; small dodecahedral crystals are said to have been imbedded in it. It yields to mechanical division parallel to the planes of the rhombic dodecahedron, and also in other directions. Its general colour is red, which occasionally is of a brown,† yellow, or orange yellow tinge. It is translucent, rarely transparent. The cross fracture is flat conchoidal; the lustre is vitreo-resinous. It scratches quartz with difficulty. Its specific gravity is 3.6, and it is fusible with ebullition into a darkish green glass. According to Klaproth, it consists of silex

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* Succin, Fr. Amber; whence Succinite.

† Its name is probably derived from the resemblance of its colour to that of cinnamon.

38.8, alumine 21.2, lime 31.25, oxide of iron 6.5. It is considered by some as having a strong affinity to the garnet. Before the blow-pipe it fuses readily into a reddish-brown or greenish glass, which is transparent.

It has been found in the sand of the rivers of Ceylon, and in Brazil.

The following substance is considered as a variety of the cinnamon-stone.

1. ROMANZOVITE.

Nordenskiold.

It is of a brown, brownish black, and black colour; and is described as occurring either compact or in crystalline plates which indicate the rhombic dodecahedron; the fracture is resinous, with a greasy lustre; it is brittle, but hard enough to scratch felspar, but is scratched by quartz: its powder is of a light yellow colour. Before the blow-pipe it melts without ebullition, and of the same colour as the mineral. Analysis by M. Nordenskiold, silex 41.24, alumine 24.08, lime 24.76, oxide of iron 7.02, magnesia and oxide of manganese 0.92, volatile parts and loss 1.98.

It has been found only in Finland.

IDOCRASE.

Vesuvian W. Idocrase H. La Vesuvienne Br. Idocrase Bt. Vesuvian J. δ CXX (10)

Idocrase occurs massive, more often in crystals, either solitary or in groups. The general form* of the crystals is a quadrangular prism, which sometimes is terminated by planes, and the edges of the prism are often replaced: their primary form is a right prism with square bases, and the crystal yields to cleavage readily parallel to all its planes, with sufficient brilliancy to obtain incidences of 90° by the reflective goniometer in every direction: the prism is divisible parallel to both its diagonals, though not easily: the cross fracture is small conchoidal, and shining. The colour of Idocrase is mostly brownish or yellowish green, sometimes orange, rarely black; it is generally translucent, sometimes nearly transparent: it is hard enough to scratch glass. That of Vesuvius consists, according to Klaproth, of silex 35.50, alumine 33, lime 22.25, and oxide of iron 7.50. Its specific gravity varies from 3.088 to 3.049. It possesses double refraction. It is fusible with ebullition into a yellowish translucent glass.

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* Idocrase in allusion to its form; a mixed figure. Vesuvian from its having been first discovered on Vesuvius.

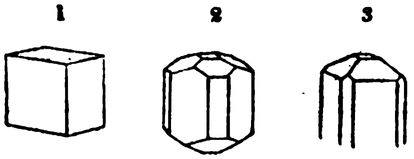
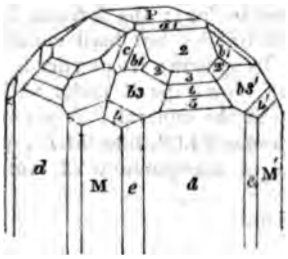


Fig. 1. The primary; a right prism with square bases. In fig. 2, the lateral edges of the prism are replaced by quadrangular planes, and a portion of the summit is replaced by four six-sided planes. In fig. 3, the quadrangular planes replacing the edges of the prism are very much increased, so as greatly to reduce the lateral primary planes.



M on M′ or *d* on *d* ..	90°00′	
P on M M′ or *d*	90.00	
M or M′ on *d*	135.00	
— — — — *e*	153.27	H
d on *e*	161.33	H
P on *a* 1	166.6	
— — *a* 2	142.48	
— — *a* 3	124.30	
— — *a* 4	113.30	
— — *b* 1	140.12	
M on *b* 1	128.5	
— — *b* 2	138.30	
— — *b* 3	145.5	
— — *b* 4	152.3	H
M on *c*	118.8	H

It has been met with both in volcanic, and in primitive countries. It occurs in the projected masses of Vesuvius and Etna; where its crystals, which exhibit no appearance of change by heat, line the cavities of volcanic rocks, principally composed of felspar, mica, talc, and carbonated lime; and are accompanied by garnet, hornblende, melanite, &c.

Idocrase has also been found in Siberia, in a greenish white serpentine, near the lake Achtaragda, and on the banks of the Wiloui; and in massive veins passing through green serpentine, in the plain of Mussa in Piedmont. In veins traversing gneiss near Mont Rosa, and on Mont St. Gothard: in gneiss in Spain. CLXXI It is also found in Kamschatka.

In Ireland, Idocrase occurs at Kilranelagh, in Wicklow (60) County, in a primitive rock composed of quartz, felspar, and garnet; and in Donegal County in a rock composed of quartz, granular limestone, &c.

The following mineral, Egeran, is considered to be a variety of Idocrase: and Berzelius mentions a ‘Magnesian Idocrase’ from Gökum and Frugord, under the name of *Loböile*; also a ‘Cupreous Idocrase’ as *Cyprine*, from Tellemarken in Norway.

1. EGERAN.

It occurs in somewhat translucent crystals, of a deep brown colour, and in the form of a right rectangular prism, each lateral edge of which is sometimes replaced. It possesses natural joints parallel to the sides and to the base of a right rectangular prism, each plane affording, by the reflective goniometer, with the next, an angle of 90°, rendering it probable that it is a variety of Idocrase, from which however it appears to differ somewhat, according to the following analysis by Count Borkowski; silex 41, alumine 22, lime 22, magnesia 3, iron 6, manganese 2, potash 1. Its specific gravity is 3.294. Before the blow-pipe it melts with intumescence into a greenish blebby glass.

It occurs at Eger[*] in Bohemia, and is sometimes accompanied by quartz and tremolite.

GEHLENITE.[†]

The Gehlenite occurs in the form of rectangular crystals, nearly approaching in their dimensions the form of the cube, and are sometimes isolated, sometimes invest calcareous spar, or are disseminated in it; but they are occasionally almost tabular. Their general colour is grey, but they have frequently a greenish or yellowish tinge. Their surfaces are commonly rough and dull, when they are opaque or nearly so; occasionally they are translucent, with surfaces sufficiently brilliant for the use of the reflective goniometer, by which they afford angles of 90° in every direction: they are somewhat inferior in hardness to quartz. The fracture is uneven, passing into splintery. The fragments are translucent on the edges. Specific gravity 2.98. Analysis by Fuchs, silex 29.61, alumine 24.80, lime 35.30, oxide of iron 6.56. Loss by calcination, 3.30. The lime, however, may be supposed to have arisen, in part at least, from veins of calcareous spar with which this substance is often traversed. Dr. Clarke detected 10 per cent. of potash in this mineral, which however was not found by Fuchs or by Dr. Thomson on a repetition of the analysis. §.LXXV

Before the blow-pipe the Gehlenite suffers no change when alone; with borax it melts with difficulty into a glass coloured by iron.

It has been found only in the valley of Fassa.

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[*] Whence Egeran.

[†] Gehlenite in honour of the chemist, Gehlen.

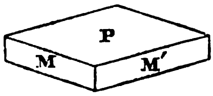
PREHNITE.*

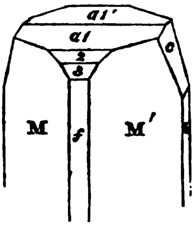
Prehnite W. H.

CXCIII It is of a pale greenish or yellowish colour, with a shining
(61) pearly lustre, and is somewhat translucent; it is scarcely hard
enough to scratch glass, and becomes electric by heat. It occur
CXCIV(62) fibrous, massive, and in crystals, which are for the most part
closely aggregated; their primary form is a right rhombic
prism of about 100° and 80°, but the crystals are subject to modification by two planes on the summit, *a* 1 *a* 1 of the following
CXCV(63) figure. It occurs in several varieties of form. Analysis by
Klaproth, silex 43.8, alumine 30.88, lime 18.3, oxide of iro
5.66, water 1.83. Of the fibrous from near Glasgow, by Dr
CXCVI Thomson, silex 43.60, alumine 23.00, lime 22.33, oxide o
(64) iron 2.00, water 6.40, loss 2.67. It is fusible with intumescence, into a pale yellowish or greenish black frothy glass.

A variety in small transparent rhombic tables (fig. 1.), (th *Koupholite*,† from the valley of Bareges in the High Pyrenees) of a white or yellowish white colour, and glistening pearly lustre, consists, according to Vauquelin, of 48 parts of silex, 24 o alumine, 23 of lime, and 4 of oxide of iron. It is fusible int a white frothy glass.

Primary form.





M on M′........	100°00′
P or M on M′...	90.00
M or M′ on *f* ...	139.45
a 1 on *a* 1′.....	177.20
— — *f*.......	92.00
— — M or M′ .	91.20
M on c	128.30

Crystallized prehnite has been met with in considerable quantity, and of a purer green than that of Europe, at the Cape Good Hope; it occurs in France; in the valley of Fassa i the Tyrol, accompanying mesotype; in Massachusetts in Nort America. In England, near the surface of the basalt fault, o Pouck Hill in Staffordshire, in distinct concretions, imbedde in sulphate of barytes, and more rarely attached to mesotyp It is also said to have been found in a trap rock at Woodford i Gloucestershire. It has lately been found with asbestus an axinite at Botallack near the Land's End, Cornwall. In Scotland it is abundant in trap near Glasgow and Dumbarton;

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* In honour of Colonel Prehn, its discoverer.

† From two Greek words, signifying a light stone.

occurs also at Edinburgh, in Fife, and in the isles of Mull, Rasay, Arran and Sky. In the north of Scotland it occurs in gneiss. In Guernsey in the same rock.

The massive is found in France, and in Connecticut and Massachusetts, North America, in trap rocks; at Hartfield Moss, near Paisley; at Frisky Hall, near Glasgow; at the Castle Rock, and Arthur's Seat, near Edinburgh; in the isle of Mull and in Sky, in trap veins traversing sandstone, and as an integrant part of a rock composed chiefly of augite, glassy felspar, and common felspar: in the Kilpatrick hills, near Dumbarton.

The variety, called the *Koupholite*, occurs in the form of the primary crystal as above represented, near Barèges, and the pic Eres-lids in the Pyrenees, in a gangue of cavernous hornstone, mingled with chlorite, &c.

STILBITE.

Zeolith W. Stilbite H. Bt. Zeolith Br. Radiated Zeolite J.

§CX III
(12)

Stilbite is of a peculiar glistening or shining pearly lustre.[*] Its colours are white, grey, and brown; it is transparent or translucent; it scratches calcareous spar, but yields easily to the knife. It occurs crystallized; the crystals are sometimes fasciculated into slender prisms: the form of the primary crystal is a right prism with rectangular bases, in which it sometimes occurs; but it often is found in prisms of which the edges are replaced and which are terminated by tetrahedral summits; the planes forming the pyramids being placed on the angles of the prism. It yields to cleavage parallel to the planes T & M, the surfaces parallel to the latter only are brilliant. It consists, according to Vauquelin, of 50.24 of silex, 29.3 of alumine, 9.46 of lime, and 10 of water. Its specific gravity is 2.5. It is electric by heat, with polarity. It runs into a blebby colourless glass.

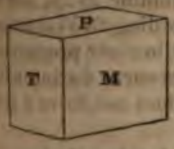
C
(65)

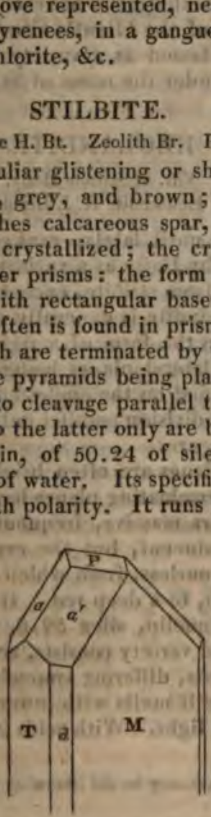
CCLVII
(

CCLIX

DXXI

Primary form.





M on T......	90°00′
P on M or T	90.00
M on a′......	120.30
a on a′......	118.50
M on d......	133.30?

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[*] Whence Stilbite, signifying a particular lustre.

Stilbite is met with in the fissures of primitive rocks; i mineral veins; and in the cavities of trap.

It has been found in Dauphiné, of a pale straw colour; a Andreasberg, upon carbonate of lime; at Arendahl, in Norway of a brown colour; in Iceland, of a shining white colour, o the Iceland spar: plentifully in the Faroe isles, in the island of Staffa and Canna, in traps of various kinds; at Glen Farg i Perthshire, and at Callhill in Aberdeenshire. In the isle o Sky, stilbite occurs in large nodules, which sometimes are easil broken: others resist a strong effort of the hand to break them yet, according to Dr. Mac Culloch, they fall to pieces in a few minutes, with a sort of violence not unlike that which is know to happen when unanealed glass has received an injury. It als occurs in the basalt of the Giant's Causeway in Ireland.

It was formerly classed as a variety of zeolite, from whic Haüy separated it, under the name of Stilbite.

HEULANDITE.*

Blatter Zeolith Werner. Var. of Stilbite Haüy. Foliated Zeolite Jameson
Heulandite H. J. Brooke.

CLX (69) This mineral was, until lately, ranked among the Zeolites and was considered by Haüy as a variety of stilbite; but it differs in every respect from stilbite, except in regard to its pearl lustre, in which heulandite is generally superior. It commonl occurs crystallized in the form of a right oblique angled prism (two of its opposed lateral planes being longer than the othe two) generally modified on the angles and one lateral edge. I yields to mechanical division parallel only to the terminal plan P of the following figures.

Externally, the planes are often bright, frequently shining and sometimes the terminating planes have a remarkably pearl lustre. It also occurs massive, frequently in a globular form It is generally translucent, but the crystals are often nearl transparent when colourless, from which it varies to white, yellowish, and brownish, to a deep red. It is easily frangible.

Analysis by Vauquelin, silex 52.6, alumine 17.5, lime 9 water 18.5. The red variety consists, according to Walmstadt of the same ingredients, differing somewhat in their proportions Before the blow-pipe it melts with intumescence, during whic it emits a phosphoric light. With acids it does not form a jelly

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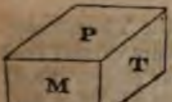
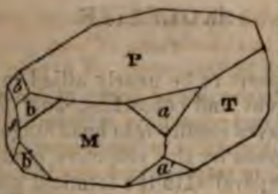
* Heulandite, as a testimony to the liberality and zeal of M. Heuland.

Primary forms.





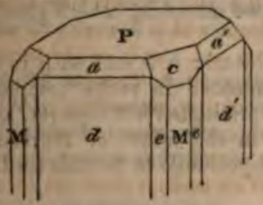
P on M or T	90°00′
M on T	130.00
— — *a*	146.30
T on *a*	148.00
P on *a*	111.56
M on *f*	114.20
b on *f*	129.40
P on *b*	133.35
— — b	108.15

It occurs in the Faroe isles, the Hartz, and in the trap of the Giant's Causeway, nearly colourless and transparent; at Paisley in Scotland, and in the Tyrol, nearly approaching to scarlet; in Norway of a brown colour.

THOMSONITE.*

H. J. Brooke.

This mineral was until lately considered to be mesotype or needlestone, from which however it differs essentially in respect of cleavage, the form of its crystals, and its composition. It occurs generally in masses of a radiating structure, in the cavities of which crystals may occasionally be observed. It is colourless and translucent in the mass, but small fragments are transparent. It possesses considerable lustre, approaching to pearly. It scratches stilbite and fluor, but is brittle. The form of its primary crystal is a right prism with square bases, and it cleaves readily parallel to its sides, affording by the reflective goniometer 90° of one plane on the next, but it does not cleave parallel to the terminating planes of the prism. Analysis by Dr. Thomson, silex 36.8, alumine 31.36, lime 15.4, magnesia 0.2, peroxide of iron 0.6, water 13.0. Before the blow-pipe it swells, curls, and becomes snow-white and opake, but does not melt. When exposed to a red heat it becomes opake, very white, and shining like enamel: the edges are rounded, but it does not altogether lose its shape, but loses 13 per cent.



M on M	90°00′
P on M or M	90.00
M on *d*	135.00
d on *d*	90.16
P on *a*	134.38
— — *c*	125.00

It occurs at Kilpatrick near Dumbarton, Scotland, in trap.

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* Thomsonite, in honor of Dr. Thomson.

SKOLEZITE.

Fuchs.

The Skolezite appears to be nearly allied to the Thomsonite. It is nearly transparent and colourless, and occurs crystallized and massive. It cleaves readily into quadrangular prisms affording angles of 90 degrees by the reflective goniometer, but does not yield to cleavage parallel to the terminal planes of the prism. It scratches glass feebly. Specific gravity 2.214. It has been analysed by Nordenskiold. It appears to consist of silex 46.5, alumine 27.7, lime 14.2, water 13.6, When a small portion is placed in the exterior flame of the blow-pipe, it becomes opaque and twists itself up like a worm,* and is finally converted into a blebby colourless glass. It dissolves readily in nitric and muriatic acid, forming a stiff jelly. It is said to be electric by heat, the pyramidal end being positive, and the other negative.

It occurs at Pargas in Finland.

WERNERITE.†

Arktizit W. Wernerite H.

This mineral is of a greenish-grey or olive-green colour, with a lustre between pearly and resinous; it is softer than felspar, and yields to the knife. It occurs massive, and in eight-sided prisms with four-sided pyramids. The massive cleaves parallel to the sides, summits, and both diagonals of an apparently rectangular prism, but not with brilliant surfaces. It consists of 40 parts of silex, 34 of alumine, 16 of lime, 8 of oxide of iron, and 1.5 of oxide of manganese. John.

This mineral occurs in crystals of the same form, and affording the same measurements as those of Scapolite, (which see). By the preceding analysis no alkali appears to enter into its composition, which however it is probable may hereafter be found; thus identifying the two minerals, which greatly agree in their external characters.

The Wernerite is a rare mineral; it is met with in irregular grains or crystallized, disseminated in rocks composed of a greyish or of a red felspar, intermingled with quartz, at Buoen, near Arendahl in Norway; in the mines of Nortbo and of Ulrica in Sweden, and at Campo-longo in Switzerland.

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* Whence Scolezite, from the Greek, in allusion to that property.

† In honor of the German mineralogist, Werner.

ZOISITE.‡

Zoisit W. Var. d'Epidote H.

It occurs in rhombic prisms, which are of a grey, or greyish E.XXIII (14) yellow or brown colour, but which are rarely perfect, owing to deep longitudinal striæ; the obtuse lateral edges of the prism are often rounded, and the terminations are incomplete. It also occurs massive, and cleaves parallel to the sides and both diagonals of a right rhombic prism of about 60° and 120° by the common goniometer, but not with brilliant surfaces. It has a pearly lustre, and is translucent. The zoisite consists of 45 parts of silex, 29 of alumine, 21 of lime, and 2.4 of oxide of iron, according to Klaproth. Alone, before the blow-pipe, it fuses on the outer edges into a yellowish transparent glass, but finally into a vitreous scoria; with borax intumesces, and fuses into a diaphanous glass.

It is met with in Carinthia, in a rock composed of kyanite, garnet and augite, and in a granitic rock; in granite in Bareuth, Franconia. It also occurs in Bavaria, in Salzburg, the Tyrol and Switzerland.

An *earthy* variety is said to occur imbedded in green talc at Radelgraben in Carinthia.

It is mentioned by Jameson as occurring at Glenelg in Inverness-shire, Scotland, and in Shetland.

EPIDOTE.

Pistacit W. Epidote H. Thallite, Karsten.

This mineral is found granular, massive, and in prismatic crystals, variously terminated and longitudinally striated. It is of a green, yellowish, bluish or blackish green colour, of a shining lustre, and is somewhat transparent. It scratches glass CCCCLI (9 with ease. The primary crystal is a right oblique angled prism,* of about 115° 30′ and 64° 30′; and it cleaves with brilliant surfaces parallel to the sides and lesser diagonal of the prism.

Crystallized Epidote consists, according to Vauquelin, of 37 parts of silex, 21 of alumine, 15 of lime, 24 of oxide of iron, and 1.5 of oxide of manganese; and its specific gravity is 3.45. Before the blow-pipe it fuses at the extreme parts, then intumesces, but does not, even by a strong heat, completely fuse. With borax it intumesces, and then fuses into a glass coloured by iron.

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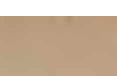
‡ Zoisite, after the Baron de Zois.

* The name Epidote was given in allusion to the form of the base of the prism, two of the sides of which being longer than the other two, the base thereby seems to have received an *enlargement* in one direction.

1



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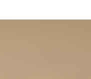

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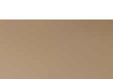
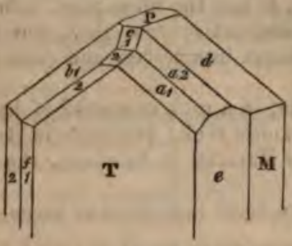


Fig. 1. The primary; a right prism of which the bases are oblique-angled parallelograms. There are several modifications of it, which commonly do not appear to have much direct affinity with the primitive. Fig. 2 exhibits one of the most simple.



M on T	115°41'
P on M or T ...	90.—
M on *e*	150.15
T on *e*	145.24
— — *f*1	145.39
— — *f*2	114.40
M on *d*	125. 2
P on *d*	145. 6
— — *c*1	148.30
T on *c*1	121.50
— — *b*1	104.30
— — *b*2	142.35

Epidote is not often found massive, but chiefly in crystals, varying in size from the acicular to near an inch in diameter; the acicular are met with in the department of Iseré, in France; at Chamouni, in the Alps, &c. (*Thallite* of Karsten); the larger occur at Arendahl, in Norway (*Acanticonite* of Dandrada). It belongs chiefly to primitive rocks, but is only found in veins and fissures; magnetic iron, garnet, felspar, adularia, axinite, and asbestus, are the minerals which chiefly accompany epidote. It occurs in primitive rocks in several places in the United States of America.

Epidote is found in the Malvern hills, in sienite: in quartz, also in schist, at Wallow Crag near Keswick, Cumberland: in Iona, one of the Hebrides, in a rock composed of red felspar and quartz; likewise in Iona in clinkstone and trap in Sky: in granite in Jersey: in Guernsey: in a vein in schist near Botallack in Cornwall. In Wicklow, Ireland, in granite.

Granular epidote. Scorza, Br. It appears by its analysis to be Epidote reduced to small grains by attrition. It occurs on the borders of the river Arangos, near Muska in Transylvania: it is called Scorza by the inhabitants of the country.

Mangânesian epidote. Manganèse oxydé silicifère, H. Epidote violet, Bt. It occurs in small prismatic crystals of a violet or reddish brown colour, which are generally associated in groups, sometimes imbedded in asbestus. It is opaque and yields to the knife. It contains about 12 per cent. of the oxide of manganese. Before the blow-pipe it fuses easily into a black glass, with borax into a transparent glass.

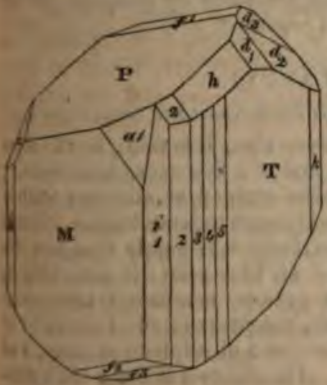
It occurs in Piedmont in gneiss accompanied by the oxide of manganese, quartz, asbestus, &c.

AXINITE.

Axinit W. Axinete H. Thumerstone J.

CCCXXX
(7

This mineral rarely occurs massive, more often in flatish crystals, of which the edges are remarkably sharp: its common colour is a sort of violet, whence it formerly obtained the name of *Violet Schorl of Dauphiné*; sometimes however it is of a wine yellow, or is nearly colourless, and transparent. The crystals do not appear to possess regular cleavages, their primary form therefore has not been determined; their general form is that of a doubly oblique prism, which is assumed as the primary form in the following figure. It scratches glass easily, but is scratched by quartz; externally the crystals are very brilliant; the fracture is small and conchoidal. Specific gravity 3.2. Analysis by Vauquelin, silex 44, alumine 18, lime 19, oxide of iron 14, oxide of manganese 4. It becomes electric by exposure to heat; before the blow-pipe it easily fuses into a dark green glass: with borax into a glass coloured by iron.



P on M	134°40′	M on *c*	112.25
P on T	115.17	— — *f*2	135.12
M on T	135.10	— — *f*3	90.18
M on *a* 1	179.00	T on *k*	147.55
— — *a* 2	150. 3	— — *h*	152. 5
— — *h*	146.35	— — *d* 1	149.30
— — *d* 1	130.30	— — *d* 2	130. 5
— — *d* 2	100.45	— — *d* 3	94.12
— — *d* 3	72.38	P — *a* 1	133.25
— — *i* 1	179.20	— — *c*	136.22
— — *i* 2	174.40	— — *f* 1	173.20
— — *i* 3	152.25	— — *h*	143.20
— — *i* 4	142.28	— — *d* 1	139.30
— — *i* 5	138.10	— — *d* 2	121.30
— — *k*′	120.00	— — *d* 3	110.20

It has only been met with in the veins and fissures of primitive rocks, and is not very abundant. It occurs in beds at Thum in Saxony: in the peak of Eredlitz in the Pyrenees, upon a

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[*] In sharpness like the edge of a hatchet, whence Axinite.

gangue of quartz, accompanied by carbonate of lime; at Bourg D'Oisans in Dauphiné; near Alençon in granite; at Mount Atlas, in Africa; near Kongsberg in Norway, in a white laminated calcareous rock, accompanied by black mica, quartz, and sometimes native silver. At Arendahl in Norway, with felspar, epidote, &c.: in gneiss in Dauphiné, and Savoy; also in mica slate in Savoy.

Axinite occurs in veins in killas at Botallack near the Land's End, Cornwall, and near the same place enters into the composition of a rock, with tourmaline and garnet: at Trewellard in the neighbourhood, both amorphous and crystallized: near St. Austle in a quarry of hornblende rock.

INDIANITE.

It is of a whitish or greyish colour with a shining lustre, but is sometimes tinged of a brown colour by a mixture of garnet or thallite; and it occasionally contains felspar, fragments of garnet, fibrolite, hornblende, mica and talc, rarely of steatite, or magnetic iron ore. It is translucent; scratches glass, but is scratched by felspar. It cleaves according to Mr. Brooke, into prisms of 95° 15'. and 84° 45'. by the reflective goniometer. Its specific gravity is about 2.74. According to Chenevix, it consists of silex 42.5, alumine 37.5, lime 15, iron 3, and a trace of manganese.

This rare substance was first described by Bournon, as the gangue of corundum from the Carnatic.*

LAPIS LAZULI.†

Lazurstein W. Lazulite H. Bt. La Pierre d'azur Br. Azure-stone J.

V'
15)

This mineral is found massive, also, it is said, in the form of the rhombic dodecahedron, and of a fine azure blue colour; the texture of the massive is fine grained or compact with a glimmering lustre, and it is hard enough to scratch glass, though it scarcely gives sparks by the steel; it is nearly opaque; Its specific gravity is 2.76 to 2.94. Its blue colour is not uniform, as it frequently encloses iron pyrites, compact felspar, and quartz. According to Klaproth, it consists of 46 of silex, 14 of alumine, 28 of carbonate of lime, 6.5 of sulphate of lime, 3 of oxide of iron, and 2 of water. On charcoal it fuses with difficulty into a white glass, when pure; when less pure it fuses more easily with intumescence.

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* Whence Indianite.

† Lapis Lazuli, azure-stone; from its blue colour.

It has been found in small masses enclosed in primitive rocks, principally in granites, accompanied by felspar, pyrites, garnet and carbonate of lime; but is more often found in small pieces rounded by attrition; as on the borders of the lake Baikal in Siberia, where also it has lately occurred in a vein traversing granite, and accompanied by calcareous spar and silvery mica. The finest specimens are brought from China, Persia, and Great Bucharia.

Lapis lazuli is used in jewellery, but is chiefly important as affording that beautiful pigment called ultra-marine, so highly valued by painters on account of its great advantage of not changing by time and exposure.

DIPYRE.

Schmelzstein W. Dipyre H.

This rare substance occurs in slender prisms, of a greyish, or reddish white colour, fasciculated into masses. A crystal in the possession of Mr. Brooke is in the form of a hexahedral prism terminated by a low pyramid, but it is dull externally. Dipyre is internally of a shining vitreous lustre; is translucent; hard enough to scratch glass; and becomes slightly phosphorescent by the application of heat. It consists of 60 of silex, 24 of alumine, 10 of lime, and 2 of water. Its specific gravity is about 2.7. Before the blow-pipe it turns milk white, and then fuses into a blebby colourless glass.*

δ. CXII
(16)

It was found in the torrent of Mauleon, in the western Pyrenees, in a gangue of white, greenish or reddish steatite, mingled with sulphuret of iron.

LAUMONITE.†

Lomonit W. H. J.

This mineral occurs in aggregated crystalline masses, deeply striated. or in separate crystals of several varieties of form, and sometimes in that of its primary crystal, an oblique rhombic prism, of which the inclination of the terminal plane is from one acute angle to the other: the prism yields to mechanical division parallel to its lateral planes and both its diagonals. It is white, or yellowish white, sometimes with a tinge of red, and is transparent or translucent, and hard enough to scratch glass. It was formerly termed the *efflorescent zeolite*, on account of its undergoing a spontaneous change by exposure to the air; in

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(71
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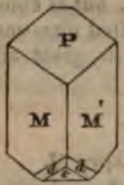
* Dipyre, from the Greek signifying the double effects of fire, in allusion to its phosphorescence and fusibility by heat.

† In honor of Gillet de Laumont.

consequence of which it loses its natural transparency, and becomes opaque, tender, of a shining white colour, and pearly lustre; eventually, it falls into a white powder similar to that resulting from the decomposition of Glauber's salt. Its specific gravity is 2.2. It is composed of 49 of silex, 22 of alumine, 9 of lime, 17.5 of water, and 2.5 of carbonic acid, according to Vogel. Before the blow-pipe it intumesces, and fuses with difficulty into a blebby colourless glass.



M on M' — — 113°.30'
P on M or M'. 86 .15
M or M on c. . 104 .20

This mineral was first discovered in the lead mine of Huelgoet in Brittany, lining the cavities of the veins. It has since been found in trap in Ireland and Faroe; also in Transylvania; in St. Gothard; and in China.

It occurs near Paisley in Renfrewshire; Kilpatrick hills near Dumbarton; near Loch Enort in the Isle of Sky, accompanied by stilbite, and at Port Rush in Ireland with analcime and stilbite in trap rocks.

It has more lately been discovered in Connecticut, in the United States of America, in a trap rock.

SLATE.

Under the term Slate, are included several substances which, from their geological position, ought rather to be classed among rocks than among simple minerals; they mostly however find a place in a cabinet. Scarcely any of them appear to have been accurately analysed; which perhaps, except in regard to individual specimens, might be of no advantage, since their external characters are liable to great variation. It is however ascertained that they primarily consist of silex.

1. CLAY-SLATE.

Thon Schiefer W. Schiste Argilleux Br. Bt.

The prevailing colour of clay-slate is grey of various shades,
CCLIII which is sometimes spotted; it is also bluish or blue; and
(73) sometimes greenish, passing into blackish green. Its structure
is schistose, and it has a glistening lustre, sometimes approaching
CCLIV to pearly; it is opaque, and yields to the knife, but varies in
(74) hardness, the softest is sometimes unctuous to the touch; it

does not adhere to the tongue. Its specific gravity is about 2.7; and it composed, by the analysis of Daubuisson, of 48 per cent. of silex, 25.5 of alumine, 1.6 of magnesia, 11.3 of oxide of iron, 0.5 of oxide of manganese, 4.7 of potash, 0.3 of carbon, and 7.6 of water. No account is given of the variety analysed. Kirwan obtained 4 per cent. of lime, but neither manganese, potash, carbon, nor water. It fuses before the blowpipe into a black slag.

Clay-slate occurs in vast strata in primitive mountains. It occasionally passes into mica-slate. It is very universally distributed.

In Britain; it is met with in Scotland and the Scottish isles, in the northern part of England, and plentifully in Cornwall, being the *killas* of the miner. The principal part of the numerous copper and tin mines of that county are situated in clay-slate, which in most countries abounds in mineral veins.

Some varieties which readily split into thin plates, are used for the roofing of houses, and for writing on; another as pencils; and some varieties as whetstones.

2. FLINTY-SLATE. SILICEOUS SCHISTUS.

Kieselchiefer W. Flinty slate J. Indurated slate A.

This substance is of about the same hardness as quartz, which commonly traverses it in small white veins. Its colour is very various; grey, bluish-grey, and red; its structure is somewhat slaty, and it is highly translucent on the edges: it is dull, or only glimmering; hard, and difficultly broken.

A specimen analysed by Weiglib yielded 75 per cent. of silex, the remainder being lime, magnesia, and oxide of iron.

It is chiefly found in beds in transition mountains, and occurs in Saxony, the Hartz, Bohemia, France, &c.

In Scotland it occurs in the long tract between St. Abb's head and new Galloway; in the Pentland and Moorfoot hills near Edinburgh, and in beds on the western side of the Isle of Sky. In Cruachan, in Raasa, in Shiant, at Talisker in Sky, siliceous schist forms beds, in contact with and involved in trap.

The *Lydian stone* or *Basanite* is considered to be a variety of Flinty slate. It is of a black or greyish black colour, and is always found massive, never with a slaty structure; it is often traversed by veins of quartz; it is opaque, less hard than flinty-slate, and its fracture is flat conchoidal.

It occurs in similar formations and repositories with common indurated slate; and is found near Prague and

Carlsbad in Bohemia; near Freyberg in Saxony; and in the Moorfoot and Pentland hills near Edinburgh. It was first brought from Lydia in Lesser Asia; whence its name.

When polished, it is used to try gold and silver upon, by a comparison of colour, and has thence obtained the familiar name of *Touchstone.*

3. WHETSLATE. TURKEY-HONE.

Wetzschiefer W. Le schiste à aiguiser Br.

IV (75) It is found massive, with a slaty structure, and is most commonly of a greenish grey colour; sometimes yellowish or brownish grey; it is translucent on the edges, yields to the knife, and is somewhat unctuous to the touch. Specific gravity 2.7.

A specimen from Iconium in Asia Minor was lately analysed by Mr. Holme, from a specimen given to Dr. Clarke by Mr. Knight of Foster-lane. It consisted of silex 72, lime 13⅓, cabonic acid 10⅓, alumine 3⅓.

It occurs in primitive mountains at Lauenstein in Bayreuth, in Saxony, and near Freyberg; it was first brought to Europe from the Levant. When cut and polished, it is used for sharpening knives and other instruments; whence its name. It is the *Novaculite* of some authors.

4. ALUM-SLATE.

Alaunschiefer W. Schiste alumineux Br.

VIII (76) One variety is of a greyish, bluish, or of an iron-black colour, and sometimes irridescent on the surface; its structure is slaty, and it is very hard; alum is obtained from it only by roasting and lixiviation. Another variety is soft, and partakes in its general appearance of the nature of slate-clay: by exposure the laminæ are separated by a saline efflorescence, and it finally falls to pieces.

The former is found in Norway and other countries of Europe, and in Scotland; the other at Whitby in Yorkshire, and in Durham.

CLAY.

Thon W. Argile H.

The substances comprehended in the term Clay, admit of no general description; but most of them agree in possessing an earthly texture; several of them in giving out the argillaceous odour when breathed on. They have not been accurately analysed, but are known chiefly to consist of silex, with a variable proportion of alumine, a small portion of lime or of magnesia, occasionally of alkali. Of all the varieties, adhesive slate is the most likely to be uniform in its constituents, since it occurs only in one place; but the analysis of Klaproth and Bucholz differ, each having found an ingredient not discovered by the other; the one manganese, the other carbon. They all appear to have been mechanical deposites; not one of them is found crystallized, or with a crystalline structure; some are slaty.

1. WACKE'.

Wacké W. Br.

It occurs massive; either solid, cellular or amygdaloidal; it is of a greenish, or yellowish grey colour, or brownish. The fracture is earthy: it is dull, opaque, yields to the knife, and is sometimes greasy to the touch. Specific gravity 2.6. It has not been analysed: it sometimes gives out the argillaceous odour when breathed upon. Before the blow-pipe it melts into a porous slag.

It occurs in most basaltic countries, and is found in different places in Scotland associated with basalt, into which it is said occasionally to pass.

2. IRON CLAY.

Eisenthon W.

It occurs massive, both cellular and amygdaloidal, and is of a reddish or yellowish brown colour; the fracture is earthy: it is opaque, dull, and easily frangible.

It occurs in Iceland, and the Faroe Islands. In Scotland, and in some of the Scottish isles in beds with basaltic and other trap rocks.

3. INDURATED CLAY.

This substance is of various shades of grey and brown; occasionally bluish. It is sometimes hard, sometimes soft; some varieties are slaty. One forms the basis of certain porphyritic rocks. Another, which has an earthy granular fracture, becomes soft by exposure, falls to pieces and then becomes plastic, occurs between beds of coal, as at Coalbrook-dale in Shropshire, and at Stourbridge in Worcestershire (Stourbridge clay.) It is very refractory in the fire.

4. SLATE-CLAY. SHALE.

Schieferthon W. Argile schisteuse Br.

Shale occurs only massive; its general colour is grey, which sometimes is bluish, yellowish or blackish; in one direction its

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structure is slaty, in the other, earthy; it is easily broken; it usually adheres a little to the tongue and yields to the nail, and is opaque, meagre to the touch, and dull, except from casually imbedded mica, which sometimes imparts a glimmering lustre: its specific gravity is about 2.6.

It is found resting upon, as well as interposed between, beds of coal, which it invariably accompanies. It often contains impressions of reeds and of ferns; and I am informed by my friend L. W. Dillwyn, well known for his curious botanical researches, that he has never discovered a single impression of fern in shale, perfect as these impressions usually are, exhibiting its well known appearance of fructification.

Black Bituminous shale has a slaty structure; when put into the fire, it blazes, crackles, and emits a black smoke and bituminous odour, loses a considerable portion of its weight, and is converted into a whitish or reddish flaky ash.

It is found in common coal, being generally more or less mixed with it.

Brown Bituminous shale is met with at Kimmeridge in Hampshire; and from its giving out a bituminous odour when placed in the flame of the candle, or in the fire, is termed
CCXIII (78) *Kimmeridge coal.* Its colour is greyish brown; it has a somewhat slaty texture, and occasionally a large flat conchoidal fracture: it yields easily to the knife, and acquires lustre by the pressure of the nail. By exposure to a considerable heat, the bituminous part is consumed, and it is reduced to a grey earthy ash.

Rottenstone. Its colour is dirty grey, or reddish brown, passing into black: it is dull, earthy, soft, meagre to the
CXL touch, and fetid when rubbed or scraped. According to
(79) the analysis of my brother, R. Phillips, it consists of 86 of alumine, 4 of silex, and 10 of carbon.

It is found at Bakewell in Derbyshire, and is believed to arise from the decomposition of the shale of that country. It occurs also at Albany near New York.

5. ADHESIVE-SLATE.

Schiste à polir Br. Adhesive slate J.

This mineral is found massive and possesses a slaty texture, which becomes visible by exposure; but if the mass be immersed in water, it resumes its former appearance. It is of a yellowish or smoke grey colour, soft, splits easily, adheres to the tongue* and is opaque. Its specific gravity is 2.080, and it is infusible before the blow-pipe. It consists according to Klaproth, of silex 82.50, alumine 0.75, lime 0.25, magnesia 8.0, carbon 0.75, iron 4. Bucholz did not detect any carbon, but found a portion of manganese.

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* Whence adhesive slate.

It has hitherto been found only in the gypsum formation around Paris, and is the imbedding substance of the menilite.

6. POLISHING-SLATE.

Polier schiefer W.

Polishing slate is of a white, yellowish white, or yellow color. It occurs massive, with a slaty texture, is opaque, brittle, and so light as to swim on water. One variety according to Bucholz consists of silex 83.50, alumine 4.0, lime 8.50, oxide of iron 1.60, water 9.0.

It is found at Kritchelberg in the vicinity of Bilin in Bohemia, in a bed resting on marle. It sometimes includes impressions of leaves and of wood, more rarely of fish. It is said also to have been found at Zwickael in Saxony, and in Auvergne, and is supposed to be a pseudo-volcanic production. It is used for polishing glass, marble, and metals.

7. PORCELAIN CLAY.

Porcellanerde W. Feldspath decomposé H. Porcelain Clay, Kirwan.

It is commonly of a yellowish-white, sometimes reddish-white. It occurs massive, and disseminated in certain rocks, and is composed of small particles which possess but a slight coherence. It adheres slightly to the tongue, and is soft and meagre to the touch. It often includes crystals of felspar, of quartz, and of mica. It is infusible, and its specific gravity is 2.216. A variety from Aue in Saxony, yielded silex 52.0. alumine 37.0. and iron 6.33.

The Saxon porcelain is made of the clay found in a bed in granite in Meissen; the Austrian from clay dug near Passau. Near Limoges in France, a bed of this clay occurs in granite, and near Bayonne. That of China is called *Kaolin*.

In Britain, a very large tract of this clay, which includes crystals of felspar, quartz, and mica, exists near St. Austle, in Cornwall, on the south side of the granite range. It supplies the porcelain manufactories of Worcester. It is said also to occur abundantly in the granite of Ireland, and sparingly in that of Scotland. It is supposed to arise from the decomposition of felspar.

CCXXIV
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8. LITHOMARGE.

Steinmark W. Argile Lithomarge H. Lithomarge, Kirwan.

Lithomarge is yellowish or reddish white; it is also grey,
LI (81) bluish or reddish, and is commonly spotted internally. It is
massive, soft, adheres to the tongue, has a greasy feel, and
gives a shining streak, and is commonly opaque, occasionally
LII (82) translucent; it is of an earthy texture, but has a large conchoidal fracture. Specific gravity, 2.209. It is infusible before the blow-pipe; it sometimes phosphoresces when heated. It occurs in veins of porphyry, and gneiss, as in Saxony, &c. and filling small cavities in serpentine; in the latter at Ehrenfriedersdorf and Altenberg in Saxony.

In England, it occurs in the tin and copper veins of Tin Croft and Cook's Kitchen mines near Redruth, which traverse both granite and schist.

Friable Lithomarge, in scaly, glimmering particles, which are phosphorescent in the dark, occurs in the tin veins of Ehrenfriedersdorf in Saxony: and some other places. Klaproth found it to consist of silex 32, alumine 26.50, iron 21, water 17, and 1.50 of muriate of soda.

9. FULLER'S EARTH.

Walkerde W. Argile smectique H.

XXXI (83) Fuller's earth occurs massive, and is usually of a greenish
brown colour, sometimes nearly of the colour of slate; it is
opaque, soft, dull, possesses an earthy fracture and a greasy
feel, and yields to, and receives a polish from, the nail: in water
it becomes semi-transparent, and falls into a pulpy impalpable
XXXII (84) powder. A variety of English Fuller's earth is composed of 53 of silex, 10 of alumine, 0.5 of lime, 1.25 of magnesia, 9.5 of oxide of iron, 1 of muriate of soda, and 24 of water. It is fusible into a porous slag. Before the blow-pipe it ultimately fuses into a white blebby glass.

At Nutfield, near Riegate, in Surry, it occurs in regular beds near the summit of a hill of considerable elevation, between beds of sand or sandstone containing fossil wood, cornu ammonis, impressions of the nautilus and other sea shells. There are two distinct beds of Fuller's earth; the upper, of a greenish clay colour and five feet in thickness, rests upon the other, which is of a light slate blue, and 11 feet thick; in these beds, but mostly in the latter, are found considerable masses of sulphate of barytes, sometimes exhibiting regular crystallizations, the interstices of which are occasionally filled up by compact quartz.

Fuller's earth is also found at Deptling, near Maidstone in

Kent, and at Aspley, near Woburn in Bedfordshire, under nearly the same circumstances as at Nutfield. At Old Down near Bath, it occurs mixed with shells, forming a bed between the upper and under oolite; and near Nottingham in lumps in the red marle. In Sussex in layers between beds of chalk.

It is found near Rosswein in Saxony, under very different circumstances to that of England. It occurs among primitive rocks, and is supposed to originate in the decomposition of green-stone-slate, beneath which it lies.

Fuller's earth was formerly much used in the fulling of cloth (whence its name), and was forbidden to be exported under severe penalties: soap is now generally substituted.

10. TRIPOLI.

Tripel W. Quarz aluminifère Tripoléen H.

This mineral has generally an argillaceous aspect. It is sometimes of a schistose texture, but is more often massive, with a coarse, dull, earthy fracture; it is meagre and rough to the touch, and yields easily to the nail. It occurs of various shades of grey, yellow, and red; and is said constantly to yield 90 parts of silex, the rest being alumine, iron, and sometimes a small portion of lime.

It was first brought from Tripoli* in Africa; it has since been found in beds at Menat near Resin, in the Puy de Dome; in Tuscany, it is met with at Volterra, so situated, as to seem the consequence of the decomposition of chalcedony; and at Post-Chapel in Saxony, in a mountain containing coal. It is also found in Flanders, Westphalia, and Russia.

It is used in polishing metals, marble, glass, and other hard bodies.

11. BOLE.

Bol W. Bole J.

Bole occurs in solid amorphous masses of a yellow, red, or brownish black colour, or pitch black (*Mountain Soap*). The yellow is translucent in the edges, the red is nearly translucent, and the brownish black opaque. It yields to the nail, but has a conchoidal fracture; gives a shining streak, adheres to the tongue, and has a greasy feel: specific gravity 1.4 to 2.0. It melts into a slag. Immersed in water it breaks in pieces.

This substance is found in wacke and basalt, from the decomposition of which it may be supposed to arise.

It occurs in Silesia, Hessia, and near Sienna in Italy.

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* Whence the name.

In the section of the cliffs near the Giant's Causeway, Ireland, basalt is interstratified with red bole or ochre; one stratum, eight feet thick, is described as being between bole and basalt; whence it may be concluded that in this instance bole is a decomposed basalt.

Mountain soap is found in the trap rocks of the Isle of Sky.

12. LEMNIAN EARTH.

Sphragid W.

Lemnian earth is yellowish grey, or white, frequently with ochreous spots on the surface. The fracture is earthy; it is dull, has a meagre feel, adheres slightly to the tongue, and when immersed in water, it falls to pieces, evolving numerous air-bubbles. Klaproth found it to consist of silex 66, alumine 14.50, oxide of iron 6, water 8.50, together with very minute portions of lime and magnesia, and 3.50 of natron.

It is dug once a year with much ceremony in the isle of Lemnos,* in the Mediterranean, where only it is found. It was formerly used in medicine; when impressed with the seal of the Grand Seignior, it was sold under the name of *terra sigillata.*

13. CIMOLITE.

Cimolite H.

Cimolite is of a light greyish-white, inclining to pearl-grey, but by exposure to air it acquires a reddish tint; it occurs massive, and of a somewhat slaty texture; is opaque, dull, and of an earthy fracture; yields to the nail, and adheres to the tongue. It often encloses small grains of quartz. It consists of 63 parts of silex, 23 of alumine, 1.25 of oxide of iron, and 12 of water. Its specific gravity is 2. It is infusible.

It abounds in the island of Cimola,† now called Argenteria, situated near that of Milo. It was employed by the ancients, and still is by the inhabitants of the island, for some of the purposes to which fuller's earth is applied.

14. MOUNTAIN-MEAL.

Bergmehl. Fabbroni.

This singular mineral was found in the form of a bed, by Fabbroni, at Santa Fiora, between Tuscany and the Papal dominions; it is formed into bricks so light as to swim on water. It consists, according to Klaproth, of silex 79, alumine 5, oxide of iron 3, water 12.

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* Whence Lemnian earth.

† Whence Cimolite.

15. BLACK CHALK.

Zeichenschiefer W. Argile Schisteuse graphique H. Schiste à dessiner Br. Ampelite graphique Bt.

This mineral is of a greyish or bluish black colour; it has a slaty texture, is meagre to the touch, and soils the fingers. It is found in primitive mountains, accompanying argillaceous schistus, particularly that which is aluminous, to which it is nearly allied; and is said to occur occasionally in the neighbourhood of coal formations. It is met with in France, Spain, Italy, Iceland, and in Bareith. That from the latter place yields by analysis about 64 parts of silex, 11 of alumine, 11 of carbon, with small proportions of iron and water.

It is used both in drawing and painting; its streak on paper is quite black.

It occurs near Pwllheli in Caernarvonshire, and in Isla, one of the Hebrides.

16. PIPE CLAY.

It is of a greyish or yellowish white colour, an earthy fracture, CCXLV (8
and smooth greasy feel; it adheres pretty strongly to the tongue, and is very plastic and tenacious. It is infusible. It is manufactured into tobacco pipes, and is the basis of the Queen's-ware pottery. An extensive stratum of pipe clay lies in a horizontal position above the chalk, extending from Handfast point to beyond Corfe Castle in Dorsetshire. It may be traced in the hills near Poole, and is found in many parts of that extensive tract called the Trough of Poole.

17. POTTER'S CLAY.

Potter's Clay is plastic, and disintegrates by exposure; is gene- CCXLV
rally of a reddish, bluish or greenish colour, and has a soft, and (
often greasy feel. When mixed with sand, it is made into bricks and tiles. A variety found in the forest of Dreux, in France, employed, on account of its infusibility, in the making of tiles for the porcelain furnaces, consists of 43 parts of silex, 33 of alumine, 3 of lime, 1 of iron, and 18 of water. Most part of CCXLVI
the clay used in the potteries in Staffordshire and Newcastle
upon Tyne, is said to be found near Teignmouth in Devonshire, (8
and is probably from some of the beds of the red marle. That of Hampshire yields by analysis 51 parts of silex, 25 of alumine, 3 of lime, with a trace of manganese and some water. Potter's clay is found among the beds constituting the plastic clay formation, as near Reading, and in some places the upper part of the London clay is used in coarse Potter's work.

18. LOAM.

Loam or brick earth, varies very much in appearance, texture, and composition. It usually contains a considerable proportion of sand; which, nevertheless, is frequently added by the brick-maker. It lies in abundance on the London clay, and frequently rests upon an interposed bed of sand. The organic remains contained in it are few, but it sometimes contains the teeth of the elephant. It is often alluvial, and mostly requires the addition of chalk.

FAHLUNITE. TRICKLASITE.

Tricklasite Leonhard.

It occurs in masses, and in layers about one fourth of an inch thick, and of a dark red-brown colour and opaque, but when reduced to small fragments it is translucent and of a yellowish brown colour by transmitted light: it scratches glass, leaving its own powder on the glass of a greyish white colour, and it yields to the knife. The texture is not generally crystalline, and the lustre is waxy, but according to Leonhard it may be cleaved into a right prism of 110° and 70°. It occasionally exhibits a tendency to the form of a six-sided prism; and analysis shews that some alliance exists between this mineral and Gieseckite, and may hereafter prove that they are identical. Analysis by Heisinger, silex 46.74, alumine 26.73, magnesia 2.97, oxide of iron 5.11, water 12.5.

It occurs at Fahlun in Sweden, imbedded in a slaty talcose rock, in a copper mine. By Lucas it is suspected to be a variety of Pyroxene, with which it seems to possess no affinity.

HARMOTOME.

Kreutzstein W. Harmotome H. Bt. Pierre Cruciforme Br. Cross-stone J.

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Harmotome sometimes occurs in flattish quadrangular prisms, terminated by rhombic planes, replacing the solid angles of the prism; these crystals often cross[*] each other lengthwise and at right angles, so that their axes coincide. The crystals yield to mechanical division parallel to the planes and both diagonals of a right rectangular prism, which is the form of the primary crystal. The colour of this mineral is greyish-white; it is translucent with a somewhat pearly lustre, and is hard enough to scratch glass. Its specific gravity is 2.35; and it is composed of 49 per cent. of silex, 16 of alumine, 18 of barytes, and 15 of water, according to Klaproth. Before the blow-pipe it fuses easily, without intumescence, into a diaphanous glass; with borax into a colourless glass.

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[*] Harmotome signifies, that which divides along the joints; alluding probably to the easy separation of the cross crystals from each other, where they join.

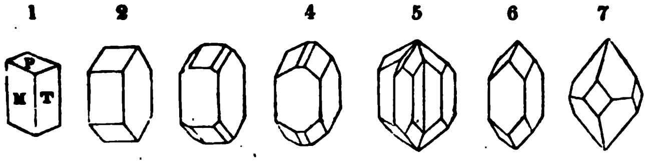
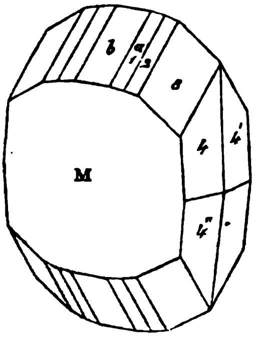


Fig. 1. The primary form, a right rectangular prism, of which certain of the angles are replaced in fig. 2, reducing it, when placed in another direction, to a six-sided prism, of which the edges are modified in fig. 3 by narrow planes, which are increased in fig. 4, and complete in fig. 6, and so increased in fig. 7 as greatly to reduce the primary planes, and to give a nearly octohedral form to the crystal. Fig. 5 represents two crystals of the same form as fig. 6, but flatter, crossing each other.



M on *b*	125°5′
b on *b* over summit	110.26
b on *a* 1	171.4
b on *a* 2	151.35
b on *a* 3	149.32
a 4 on *a* 4′ or *a* 4 on *a* 4″	177.28

In cruciform crystals it occurs in metalliferous veins, mingled with lamellar carbonate of lime and sulphuret of lead, at Andreasberg in the Hartz; it is also met with both in perfect and cruciform crystals at Strontian in Argyleshire, Scotland, and at Kilpatrick hills Dumbarton accompanying analcime. Solitary crystals also occur in the cavities of siliceous geodes at Oberstein in Saxony.

AMIANTHOIDE.*

Amianthoïde H. Bt.

It occurs in long capillary filaments of an olive green colour, very flexible, and extremely elastic; the latter character points out the difference between this substance and amianthus, which though it is very flexible is not at all elastic, and common asbestus which is scarcely flexible. It is of a brilliant silky lustre and is composed according to Vauquelin of 47 silex, 11 lime 7 magnesia, 20 of oxide of iron, and 10 of manganese.

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* From its general resemblance to amianthus.

It is found in Oisans in France, with carbonate of lime, epidote, felspar, quartz, &c.

1. BYSSOLITE,[*] Saussure.

This mineral is of about the same colour as amianthoide, but differs in occurring in short and somewhat stiff filaments, which are apparently rhombic prisms, implanted perpendicularly on the surface of certain stones, in the manner of mosses. It has been found at the foot of Mont Blanc, and also near Oisans on gneiss.

AUGITE. PYROXÈNE.[†]

Augit W. Pyroxène H.

CLVI } 17
CLVII }

It occurs crystallized, also in grains and amorphous. The crystals are generally small, and they are often hemitrope or macled. It occurs of a green colour, also brown or brownish black, sometimes black, with or without lustre, and opaque. It cleaves parallel to the sides of an oblique rhombic prism of 87° 5′ and 92° 55′ by the reflective goniometer, which therefore is the primary form of its crystals; the terminal planes, however, parallel to which it does not cleave, are assumed, but confirmed by the crystals of Pargas in Finland, which readily divide parallel to the terminal plane, owing to the intervention of calcareous spar between the laminæ: the terminal planes decline from one acute angle of the prism, to the other: it scratches glass, and sometimes gives sparks with the steel. The black variety of Frascati yielded to Klaproth 48 of silex, 5 of alumine, 24 of lime, 8.75 of magnesia, 12 of oxide of iron, and 1 of manganese. Analysis of that of Sala in Sweden by Rose, silex 54.86, lime 23.57, Magnesia 16.49, protoxide of iron 4.44, protoxide of manganese 0.42, alumine 0.21. Before the blow-pipe it fuses easily into a dark coloured glass.

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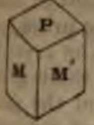
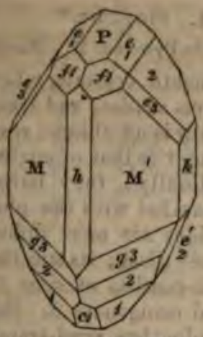
[*] From its resemblance to lichen or moss.

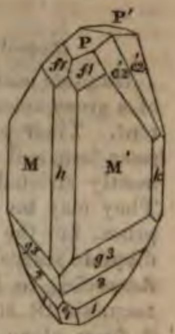
[†] Augite from the Greek, splendour; in allusion to the brilliancy of its crystals; Pyroxèna signifying a guest in the domain of fire—unaltered by heat.

Primary form.





Macle.



M on M′	87° 5′	P on *f*1	146° 15′
M or M′ on P ..	100.10	*e*1 on *é*1	120.38
—— —— *h* ...	133.33	*e*1 on *k*	138.48
—— —— *f*1..	134.40	*e*2 on *e*3	164.00
—— —— *g*1..	122.15	*f*1 on *f*1	131.30
—— —— *g*2..	144.25	*g*1 on *g*1	120.38
—— —— *g*3..	155.33	*g*1 on c1	150.18
—— —— *e*2..	132.00	*g*3 on *g*3	87.10
M′ on *k*	136.15	*h* on c1	105.20
P on *h*	106.15	P on P′ macle	148.30
—— *e*1........	150. 2	*é*2 on *é*2	159.50
—— *e*2........	131.30		

Augite is met with in the productions of volcanoes; but whether it existed in certain rocks, previously to their being subjected to volcanic action, or whether it has been formed in the lavas and scoriaceous matters in which it is found, since their ejection, is matter of uncertainty and dispute. The greater number of mineralogists incline to the former opinion. It is found in the volcanic countries of Vesuvius, Etna, Stromboli, Auvergne, Teneriffe, and Bourbon, &c. It is also said to occur in the basalts of Bohemia, Hungary, Transylvania, Hessia, and in the iron mines of Arendahl, in Norway. The crystals met with in basalt are larger, of a finer green, and more brilliant than those found in lavas.

It is found in primitive trap in Norway, with garnet, mica, actynolite, calcareous spar, &c. and in primitive limestone in the Pyrenees, and in the island of New York, United States.

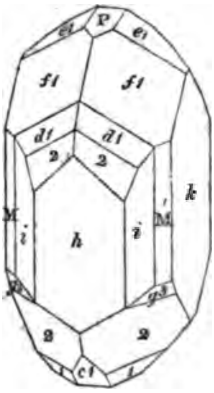
In Britain, it occurs plentifully interspersed in a substance somewhat resembling steatite in the summit rocks of Moel Shabod and Penmanmawr in North Wales; in the trap dykes of the isle of Anglesea, and near Bangor; with olivin in the basalt of Teesdale; in the trap rocks around Edinburgh; and in the Orkney islands and several of the Hebrides.

The five following substances are varieties of augite.

1. DIOPSIDE.*

'11 Diopsid W. Var. de Pyroxène H. Mussite. Alalite.

'7 Diopside occurs in prismatic crystals, which are colourless o of a green colour of various shades, and translucent or transparent. Their primary form is an oblique rhombic prism, of th same form and measurement as that of augite. The crystals ar mostly striated longitudinally: they have a shining lustre They may be cleaved parallel with the planes of the primar prism, but the terminations are most difficult of attainment. diopside scarcely scratches glass; its specific gravity is 3.310. According to Laugier it consists of silex 57.50, lime 16.50, magnesia 18.50, iron and manganese 6. Before the blow-pipe it fuses alone into a colourless semi-transparent mass; wit borax into a diaphanous glass.



M on M′	87° 5′	
M or M′ on P	100.25	
—— —— *h*	133.35	
—— —— *f*1	134.45	
—— —— *g*1	122.10	
—— —— *g*2	144.12	
—— —— *g*3	155.35	
—— —— *i*	152.35	
M′ on *k*	136.17	
P on *h*	106.30	
*f*1 on *f*1	131.30	
*g*2 on *g*2	95.25	
*g*3 on *g*3	87.18	
h on *i*	162.30	
*d*1 on *h*	165.00	*c g*
*d*2 — —	175.00	,,
*d*2 on *d*2	170.00	,,

It was first discovered by Bonvoisin on the plains of Muss in Piedmont in veins traversing serpentine: it is accompanied by epidote and garnet.

2. PYRGOM. FASSAITE.†

'111 '7 This mineral is generally of a dingy green colour, assume nearly the same crystalline form, and readily yields to mechanical division parallel to the lateral planes of a prism of th same measurements by the reflective goniometer, as that augite.

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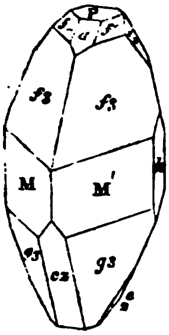
* From the Greek, signifying transparency; in allusion to the (occasion transparency of its crystals.

† Fassaite from the valley of Fassa in the Tyrol, where it was discovere



M on M'	87° 5'
M or M' on P	100.12
—— —— f2	146.30
—— —— f3	169. 5
—— —— c2	125.30
—— —— g3	155.20
M' on k	136.10
f2 on f2	120.20
f3 on f3	95.38
g3 on g3	87. 5
P on a	148.23
—— f2	137.50
—— f3	114.40
f2 on a	150. 1
g3 on c2	183.32

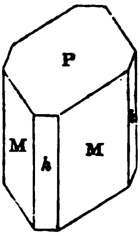
It is found in the valley of Fassa in the Tyrol.

3. SAHLITE.

& CLX

Sahlit W. Pyroxène laminaire gris-verdatre H. Malacolithe Bt.

Sahlite occurs in prismatic crystals of four or eight sides, and generally with inclined summits; it is of a greenish grey colour, and scarcely hard enough to scratch glass; it is often translucent. It also occurs massive. The structure is lamellar, with joints parallel to the planes of an oblique rhombic prism, of the same measurements by the reflective goniometer as that of Augite; the primary form of the two substances is therefore the same, but sahlite readily allows of mechanical division parallel to the oblique terminal planes of the prism, which augite rarely does. Specific gravity 3.256. Sahlite is composed of 53 of silex, 3 of alumine, 20 of lime, 19 of magnesia, and 4 of oxide of iron and manganese, according to Vauquelin. Analysis of a greenish white specimen from Tammare in Finland, by Von Bonsdorff, silex 54.83, lime 24.76, magnesia, 18.55, alumine 0.28, oxide of iron 0.99, vol. matter, 0.32. Before the blow-pipe it melts *per se*, with slight effervescence into a translucent glass. It is dissolved by borax, microcosmic salt and soda, forming with them a clear glass.



M on M	87°5'
—— on P	100.40
—— on h	133.34
M on k	136.35
P on h	106.12
—— k	90.00
h on k	90.00

It has been found in the silver mines of Sahla* in Sweden.

* Whence Sahlite.

Baikalite. Baikalite W. This substance so completely resembles Sahlite in its external characters, that although it has not been analysed there is no doubt of their identity. The form of the crystal is precisely that of Sahlite, and it affords the same measurements by the reflective goniometer: it cleaves, also, parallel to the sides and summits of an oblique rhombic prism similar in form and measurement to the primary form of that mineral, with which it agrees in colour.

It is found in granite, with calcareous spar, on the banks of the Lake Baikal † in Siberia; in a similar situation in Scandinavia, and according to Jameson in primitive limestone in Rannock in Westmania, in Sweden, and at Buoen, near Auen, in Norway. It has also been met with in the mountain of Odon-Tchelon, in Siberia, accompanied by mica, beryl, and crystallized phosphorescent carbonate of lime: and near Lake Champlain in North America.

4. EUCHYSIDERITE.

This mineral has very lately been introduced into this country only in the form of prisms, having the same measurements as those of Augite, but they are without regular terminations of any sort. The surface is considerably brilliant, although it generally possesses a somewhat ochreous tinge, and from its easy fusibility it may be considered as an Augite, of which iron enters into the composition in an uncommon degree.

It is found at Bærun's-grube, Norway.

5. COCCOLITE.

Kokkolith W. Pyroxène granuliforme H.

The Coccolite is of various shades of green and bluish green, and occurs in little translucent masses, or in grains * of irregular shapes, which are very slightly coherent; it is hard enough to scratch grass: the structure is lamellar, and the lustre vitreous. It consists of 50 per cent. of silex, 1.5 of alumine, 24 of lime, 10 of magnesia, 7 of oxide of iron, and 3 of oxide of manganese, according to Vauquelin. It is infusible. Specific gravity 3.3.

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† Whence Baikalite.

* Whence Coccolite from the Greek, signifying a granular stone.

It is said to have been met with only in primitive countries; in certain veins near Arendahl, in Norway, and Nericia, in Sweden; and in the iron mines of Hellesta and Assebo, in Sudermania. It also is found at West Chester, in New York, North America, and near Lake Champlain in Vermont, frequently in large masses of various colours. When mixed with serpentine it has been termed *Lherzolite.*

HORNBLENDE.

Hornblende W. Var. de Amphibole H.

Hornblende occurs crytallized, massive, and slaty.

Crystallized hornblende is found in prismatic crystals, occasionally distinct, but more often confusedly aggregated, and frequently macled. The crystals cleave readily and with brilliant surfaces, parallel to the sides of a rhombic prism of 124° 30′. and 55° 30′. by the reflective goniometer, but not parallel to the terminal planes, which are assumed to be oblique to the axis of the prism; and hence the primary crystal is an oblique rhombic prism, the declination of the terminal planes being from one obtuse angle of the prism to the other. It is of a dark bottle green colour, or a brownish green, or brown approaching to black; but when pulverized or bruised, of a greenish grey: its lustre is shining; it yields pretty easily to the knife; is opaque, or only translucent on the edges; is tough, and indented by the stroke of a hammer. Its specific gravity is 3.6. It consists, according to Klaproth, of silex 42, alumine 12, lime 11, magnesia 2.25, oxide of iron 30, ferruginous manganese 0.25, water 0.25. Analysis of a deep green variety from Aker by Bonsdorff, silex 47. 21, alumine 13. 94, lime 12. 73, magnesia 21. 86, protoxide of iron 2. 28, protoxide of manganese 0.57, fluoric acid 0.90, water 0.44. The almost white varieties differ in possessing less iron, and more of their earthy ingredients; in the black, the iron has been found to amount to about 19 parts. Dark green lamellar hornblende fuses alone, before the blow-pipe with effervescence and intumescence into a black brilliant glass: the black crystallized fuses readily with violent bubbling into a brown grey opaque glass.

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CCCCLXV
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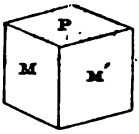
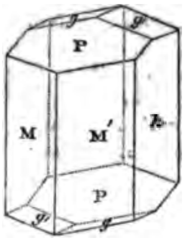
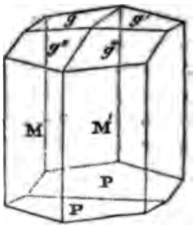
Primary form.







M on M'	124°30'	P on k	90°00'
M or M' on P	103. 1	g' on k	106.00
M' on k	117.32	g on g'' or g' on g'''	148.42
P on g or g'	145.43		
M on g or g'	68.42		
g on g'	148.22		

The 3d fig. represents a *macle* in which one half of the crystal is half tur round, and is thus attached to the other half.

XVIII (91) *Massive* Hornblende is of a crystalline structure, consisting minute and often of long crystals intersecting each oth sometimes confusedly radiating. It often assumes a fen ginous brown on the surface frem decomposition. It commonly very tough and difficult to break.

LXVII (92) *Hornblende slate*, Hornblende Schiefer W. It is commo of a greenish black colour; and in this as well as other characters, agrees with the massive, except that t is of a slaty or schistose structure.

Hornblende is a very abundant mineral, since it is occasion found in many varieties of rock, and sometimes enters ve largely into their composition. It is occasionally found b in basalt and lava.

It is found in almost every country.

In Britain, it occurs occasionally, though but sparingly Cornwall, as an ingredient in the greenstone of Mullyan Cov perhaps in the greenstones or basalts of our coal-formations, a forms the prevailing rock of the Malvern hills. In the sieni gneiss, and mica-slate of Scotland, and in the traps of th country and most of the Scottish Isles.

There are several minerals which are justly considered varieties of hornblende.

1. BASALTIC HORNBLENDE.

Basaltische Hornblende W. Var. de Amphibole H.

Basaltic hornblende is usually met with in opaque sing crystals; it sometimes affects the magnetic needle. The usu colour of this mineral is black; or brownish black, occasioned by a slight decomposition. The crystals are six-sided, and variously terminated by three or four planes; but are sometimes dissimilar at the two extremities, in which case they are macled or hemitrope crystals; their primary form is identical with that of common hornblende: the crystals have a vitreous lustre, and are hard enough to scratch glass. The specific gravity of this mineral is 3.25; and it is composed, according to Klaproth, of 47 per cent. of silex, 26 of alumine, 8 of lime, 2 of magnesia, and 15 of iron.

It melts with difficulty into a blackish glass.

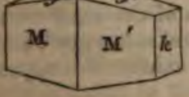
It is most commonly found in basalt and lava, but occurs more sparingly in wacké and certain porphyries.

According to Jameson, it occurs in the flœtz-traps of the Saxon Erzegebirge, Bohemia, Silesia, Bavaria, Hungary, Italy, France, and Spain.

In Britain, in the basalt of Arthur's Seat and other hills near Edinburgh, in that of Fifeshire, and in that of the Isles of Mull, Canna, Eig, and Sky. It is also said to be found in the basaltic rocks of England and Ireland.

2. PARGASITE.

It occurs disseminated in somewhat round semi-crystalline masses, and in six-sided crystals with diedral summits. It yields to cleavage parallel to the lateral planes of a rhombic prism, of the same measurements as the oblique rhombic prism of hornblende, but not parallel to the terminal planes. In fact it is difficult to point out any difference between hornblende and pargasite, except that the latter is somewhat translucent, and of a lighter green, or more generally of a bottle green colour. It is harder than fluor, and scratches glass, but is scratched by quartz. Specific gravity 3.11. It is said to consist of silex 42.01, magnesia 18.27, lime 14.28, alumine 14.08, oxide of iron 3.52, oxide of manganese 1.02, oxide of a metal not investigated 0.33, fluoric acid and water 3.00. Thomson's Annals. The effects of the blow-pipe on it are the same as upon black crystallized hornblende, except that the glass is less coloured.



M on M'	124°30'
M' on *k*	118.10
M on *g* or M' on *g'*	68.48
g on *k*	105.32
g on *g*	147.54

It is found at Pargas* near Abo in Finland in calcareous spar.

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* Whence Pargasite.

3. HEDENBERGITE.

Hédenbergit Leonhard.

This mineral is of a dark bottle, or of a blackish green colour, and possesses much of the external characters of those varieties of hornblende in which iron prevails, and agrees with that substance in yielding readily to mechanical division parallel to the sides of a rhombic prism of 124°. 30′, & 55°. 30′, by the reflective goniometer. It occurs massive; its specific gravity is 3.154. It was first analysed by Hedenberg,* according to whom it consists of silex 40.62, alumine 0.37, water 16.5?, protoxide of iron 35.25, oxide of manganese 0.75, carbonic acid 4.93; but it is said to have been since analysed by Rose, who found it to consist of silex, lime, and protoxide of iron. According to Berzelius, *alone* it gives off no water, but fuses in the forceps with exceeding slight effervescence into a black shining glass; with borax, easily into a glass coloured by iron.

It is found near Mormorsgrufva near Tunaberg in Sweden, accompanied by calcareous spar, quartz, and mica.

4. CARINTHIN.

This mineral also yields to cleavage parallel to the sides of an oblique prism of the same measurements as that of hornblende, by the reflective goniometer, but one plane is more brilliant than the other, and possesses a somewhat metallic lustre. It is of a green colour and very soft.

It occurs in the Sau Alpe in Carinthia,† accompanied by quartz, hornblende, and kyanite.

5. TREMOLITE.‡

Tremolith W. Var de Amphibole H. Tremolite Br. Grammatite Bt.

Crystallized Tremolite. Common Tremolite J. Its general colour is white (Amphibole blanc H), which sometimes has a greenish, bluish, yellowish or reddish tinge: it occurs in masses composed of delicate crystalline fibres which sometimes radiate, and in very flat, and deeply striated four, six, or eight sided prisms, rarely terminated by diedral summits. It cleaves, with brilliant surfaces parallel to the sides of a rhombic prism of the same measurement as that of hornblende, by the reflective goniometer; and the crystals of tremolite often exhibit the appearance of

ccXCII
(93)

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* Whence it was named Hedenbergite.

† Whence Carinthin?

‡ Tremolite from the valley of Tremola, where it was first discovered.

fissures which are oblique to the axis of the prism. It is semi-transparent or translucent, and hard enough to scratch glass, but is very brittle; it becomes phosphorescent both by heat and friction. Its specific gravity is 2.9. It consists according to Laugier of silex 50, lime 18, magnesia 25, carbonic acid and water 5. Before the blow-pipe, it fuses by a very strong heat into an almost opaque grey-white mass.

Granular Tremolite. It occurs white slightly tinged with green, is fine grained, the fracture is uneven, and has very much the aspect of some varieties of marble. It is described by Dr. Mac Culloch as occurring in Glen Tilt in Scotland.

Fibrous Tremolite. Glassy Tremolite J. This variety differs from the preceding, only in the arrangement of its parts. It appears to consist of minute crystals, which sometimes are so intimately associated as to become massive. They occasionally diverge. It is commonly intersected by cross seams, like fractures. It is generally translucent and brittle. It has a shining or pearly lustre.

DLX

Asbestiform Tremolite. Asbestous Tremolite J. It occurs in masses consisting of fasciculated groups of minute diverging fibres; its fracture exposes a delicately fibrous texture, with a glistening, pearly or silky lustre. Occasionally it is radiating. It becomes phosphorescent by friction, which is not the case with common asbestus, which it much resembles. Before the blow-pipe, that from Sheffield in Massachusets, bubbles and fuses with great difficulty into a vitreous mass.

In the valley of Tremola, Tremolite occurs in dolomite, as well as in Switzerland and in the United States of North America. It is found in Norway and Bohemia, on Mount Vesuvius, and in several places in the United States in limestone. In Corsica in talc; near Nantes in granite abounding in felspar. It occurs in most European countries; also on the banks of the lake Baikal in Siberia.

In Britain, fibrous tremolite occurs at Clicker Torr in Cornwall, in dark green serpentine with asbestus, and at Stenna Gwyn on decomposed granite with uranite. In Scotland, Tremolite occurs in primitive limestone in Aberdeenshire and Icolmkill; in basalt in the Castle rock, Edinburgh; in Glenelg in Inverness-shire, and in the marble of Glen Tilt. It is found in the isles of Unst, Tiree, and Harris.

Calamite.[*] It occurs in rhombic prisms of a light green colour, translucent, striated longitudinally, and yielding to mechanical division readily, parallel to the sides of a rhombic prism of the same measurements as that of hornblende, by the reflective goniometer. The crystals are traversed by fissures nearly parallel to the terminating planes of the primary crystal of hornblende. This mineral is soft, and in the form of its crystal resembles Tremolite.

It occurs in serpentine with magnetic iron and calcareous spar, near Normark in Sweden.

Pyrallolite. Pyrallolit, Nordenskiold. This mineral occurs both massive, and crystallized in flat rhombic prisms greatly resembling those of tremolite, and is divisible parallel to the planes of a rhombic prism; but it cleaves more readily in one direction than the other, apparently also to its lesser diagonal, but not with brilliant surfaces, the prisms are generally above an inch in length, are described as being occasionally of a greenish tinge, but by exposure becoming yellowish or pale yellow, and are then very soft and friable. It is opaque in the mass, but when reduced to thin laminæ parallel to the principal cleavage, it is translucent. Specific gravity 2.57. If thrown in the state of powder upon a red hot iron, its gives out a bright bluish phosphorescence. Analysis by Nordenskiold, silex 56.6, alumine 3.4, lime 5.6, magnesia 23.4, oxides of iron and manganese 1.1, bituminous matter and loss 6.4. Before the blow-pipe it first becomes blackish, afterwards white, and the edges are reduced to a white enamel.

It is found at Pargas in Finland in calcareous spar, with augite, felspar, and scapolite.

6. ACTYNOLITE.

Strahlstein W. Var de Amphibole H.

This mineral is of a pale green colour, which sometimes is
CCXCII yellowish or brownish. It may be divided into three varieties,
(95) crystallized, asbestiform, and glassy.

Crystallized Actynolite occurs in single crystals, but more often in columnar masses consisting of hexahedral prisms, which, in the general, are not regularly terminated, but which yield by mechanical division a prism of the same measurements as that of common hornblende. It has a shining lustre, and is translucent or transparent; it also occurs in fine fibres, having a silky lustre, and sometimes disposed in a radiating form.[*] It is hard enough to scratch glass: its specific gravity is about 3.3. Crystallized actynolite, according to Bergmann, is composed of 64 per cent. of silex, 2.70 of alumine, 9.30 of lime, 20 of magnesia, and 4 of oxide of iron. It melts into a greenish enamel.

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[*] Calamite; calamus (Latin) a reed; from the appearance of its crystal-

Asbestiform actynolite occurs of a green, greenish grey, and brownish green, both massive, and in capillary crystals which are elastic. The crystals are sometimes disposed in wedge-shaped masses, or in radii, sometimes promiscuously aggregated; they are opaque or slightly translucent on the edges. It melts before the blow-pipe into a yellowish brown opake glass. Its constituents are nearly the same as the preceding. The *Byssolite* of Saussure, which has already been noticed as a variety of amianthoide, is by some supposed to be this mineral.

CCXXX (9

CCCLXXI (9

CCXXVI (9

Glassy actynolite. It differs from the preceding variety in possessing an external lustre, which is vitreous inclining to pearly, and in being translucent and brittle.

CCXXIV (9

Actynolite is chiefly found in primitive rocks; as in gneiss, mica-slate, and limestone.

It occurs in long six-sided prisms imbedded in white talc, at Zillerthal, in the Tyrol, and in Mount St. Gothard; it is also met with near Salzburg, in Saxony; in Norway; and in Piedmont.

In Britain, it occurs in the copper veins of the Maudlin mine, near Lostwithiel in Cornwall; the glassy, with tin in Huel Unity, near St. Die, and the asbestiform in the rocks of the coast near St. Michael's mount. The glassy variety occurs in globular concretions in the amygdaloid of Caer Caradoc in Wales. In Scotland, the crystallized is found at Eilan Reach, in Glen Elg, Inverness-shire; in Sleat in Sky, and in the Isle of Lewis; the glassy in Sky.

ANTHOPHYLLITE.[†]

Anthophyllite H. J.

E.CVIII 19

Anthophyllite is of a brownish colour, and glistening, pearly, pseudo-metallic lustre; it occurs massive, the mass consisting of crystals or crystalline fibres often disposed in a radiating form; the crystals may be cleaved parallel to the lateral planes of a rhombic prism of about 125° and 55°, and both its diagonals; the latter are not brilliant. The prism is generally traversed by natural crevices nearly at right angles to the axis of the prism; it is feebly translucent on the edges; it is scarcely hard enough to scratch glass, but scratches fluate of lime. Its specific gravity is about 3.3. By analysis it is found to consist of 56.01 of silex, 13,30 of alumine, 14 of magnesia, 3.33 of lime, 6 of oxide of iron, 6 of oxide of manganese, and 1.43 of water. It is infusible before the blowpipe alone; with borax, it fuses with difficulty into a glass coloured by iron.

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[*] Whence Actynolite from the Greek, in allusion to the sun's rays.

[†] From its resemblance in colour to the Anthophyllum, a flower.

It occurs at Kongsberg in Norway, with hornblende, and is said to have been discovered in granite in Mecklenberg: it is found in Greenland.

HYPERSTHENE.*

Labradorische Hornblende W. Var. de Diallage Metalloïde H.
Hypersthène Bt.

Hypersthene is met with either massive, or imbedded in rocks. Its colour is dark brown, or greenish black; it has a lamellar structure parallel with the diagonals and sides of
CCLXXVII rhombic prism of about 87° and 93°. The cleavage of one side
(100) of the prism is more easily obtained than the other. When fractured, it exhibits reflections which are strongly metallic, and sometimes greenish, sometimes of a copper red colour: this lustre is observable in one direction but not in the other; when reduced to very thin laminæ, it is translucent, with a slight tinge of green in one direction, but opake in the other; when pulverized it is dark grey; it yields to the knife. Its specific gravity is 3.38; and it consists of 54.25 of silex, 2.25 of alumine, 1.5 of lime, 14 of magnesia, 24.5 of oxide of iron, and 1 of water. Before the blow-pipe, on charcoal, it fuses easily into a greyish green opaque glass; with borax into a greenish glass.

It was first found on the coast of Labradore, whence the name *Labradore hornblende*, chiefly in rolled masses, but it also occurs as a constituent of a rock chiefly consisting of Labradore felspar; and has also been found crystallised, as I am informed by T. Allen, Esq. of Edinburgh, in Greenland by Geisecke.

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* From the Greek, in allusion to its difficult frangibility.

SCHILLER SPAR.*

Schillerstein W. Var. de Diallage metalloïde H. Schillerspath Br. Diallage chatoyante Bt.

It is of an olive, or bottle green colour, occasionally brownish green, and when held in certain directions, has a shining lustre, which is occasionally somewhat metallic: it is opake and yields to the knife. It fuses, though with some difficulty, into a CCCXXXI blackish enamel. By one analysis it yielded 41 of silex, 3 of (10 alumine, 1 of lime, 29 of magnesia, 14 of oxide of iron, and 10 of water.

It is commonly found in serpentine, occasionally in other rocks, as in greenstone at Basta in the Hartz. It occurs in serpentine at Zöblitz in Saxony, in Salzburg, and in the Tyrol.

In Britain, it is found in Cornwall, in serpentine, in Coverack Cove, and near St. Keverne; in the same rock in Anglesea; in Scotland, as between Ballantrae and Girvan in Ayrshire, and at Portsoy in Banffshire; in greenstone rocks in Fifeshire, and in porphyritic rocks on Calton-hill and at Dumbarton.

SMARAGDITE.†

Smaragdit, Saussure. Diallage verte H. Diallage J.

Smaragdite is of a brilliant or emerald green colour, and of a silky or pearly lustre, and transparent at the edges, sometimes opaque: it is scarcely so hard as glass, and yields to the knife; it has a laminated structure, with joints parallel to the sides and diagonals of a slightly rhombic prism. Its specific gravity is 3; and it is composed of 50 of silex, 21 of alumine, 13 of lime, 3 of magnesia; the remainder being oxide of chrome and oxide of iron, according to Vauquelin. It fuses into a grey or greenish enamel.

It is found massive, or disseminated in rounded masses of the Saussurite, on the banks of the Lake of Geneva: near Turin it occurs at the foot of the mountain Mussinet; in Corsica imbedded in felspar, or with Saussurite; in the latter on Mount Rosa in Switzerland.

ASBESTUS.

There are several varieties of Asbestus. They are generally of a fibrous texture, but vary in respect of flexibility. The fibres of asbestus have not yet been seen in any very determinate form, but Haüy regarded some which fell under his observation as rhombic prisms. Asbestus * is extremely difficult of fusion in the mass.

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* From the German, signifying Chatoyant spar.

† From the Greek, signifying a green stone—an emerald.

1. AMIANTHUS.

Amianth W. Asbeste flexible H.

Amianthus occurs in very long and extremely slender fibres, which are very flexible and elastic, and of a whitish, greenish, or reddish colour. It is somewhat unctuous to the touch, has a shining or silky lustre, and is slightly translucent. It consists of 59 per cent. of silex, 3 of alumine, 9 of lime, and 29 of XXI magnesia, according to Chevenix. In mass it is fusible with (102) difficulty into a white enamel, which however is readily effected by exposing a single fibre to the flame of a candle.

It is commonly found in veins in serpentine.

It is found in the Tarentaise in Savoy, in the longest and most beautiful fibres: that of Corsica is less beautiful, but is so abundant that Dolomieu used it for packing his minerals: near Barèges in the Pyrenees, it occurs mingled with felspar, lining veins passing through gneiss. It occurs in Dauphiné and St. Gothard in veins in mica-slate: in serpentine in several of the United States.

In Britain, it occurs in veins in serpentine at St. Keverne, Cornwall: in serpentine in Portsoy in Scotland; and in Aberdeenshire, Argyleshire, and Fifeshire, and in the Isles of Unst and Fetlar; in mica-slate in Glen-Elg, Inverness-shire. In Durham it has been found in a hard rock resembling basalt.

Amianthus was woven by the ancients into a kind of cloth, in which, being incombustible, they wrapped up the bodies of their dead, before they were placed on the funeral pile, that their ashes might be collected free from admixture.

2. COMMON ASBESTUS.

Gemeiner Asbest W. Asbest dur. H.

Common asbestus is much heavier than the preceding variety, XXIII being nearly three times the weight of water. It occurs in masses consisting of fibres of a dull greenish colour, and occa(103) sionally of a somewhat pearly lustre. It is scarcely, or not at all flexible, and thereby is distinguishable from amianthus, which is considerably flexible. It is somewhat unctuous to the CXXVI touch, and is fusible before the blow-pipe readily into a slightly greyish enamel. According to Chevenix its constituents are (104) nearly the same as those of amianthus.

It is of more frequent occurrence than amianthus: is usually found in veins in serpentine; and is met with in Sweden, Hungary, Dauphiné, the Uralian mountains, &c.

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* Its name is derived from a Greek word, signifying imperishable, or according to some, unstained, unsoiled.

It is found in serpentine at Portsoy in Scotland, the Isle of Anglesey, and at the Lizard in Cornwall: the soapstone of the latter place sometimes appears to pass into asbestus.

Dr. MacCulloch found in the limestone of Glen Tilt asbestus so soft, that it might be wrought into a paste with the fingers; but it acquired in a few days a hardness equal to that of fir-wood.

3. MOUNTAIN LEATHER.

Variety of Rock-Cork. J. A.

The principal difference between this and the foregoing variety, appears to be the position of the fibres. In common asbestus, they are generally even and parallel: in mountain leather, they are interwoven or interlaced. It occurs in flexible CXXII flat pieces, having much of the aspect of leather; but when very thin it has by some been termed *mountain paper*. (105 It is commonly of a whitish or yellowish white colour, and is meagre to the touch.

It occurs at Strontian in the Lead hills at Wanlock head in Lanarkshire, Scotland.

4. MOUNTAIN CORK.

Berg Cork W. Asbeste tressée H. Rock Cork J.

Mountain cork is of a fibrous texture, the fibres being interlaced. It is opaque, has a meagre feel, somewhat resembling that of common cork, being of about the same hardness; it is somewhat elastic. It is so light as to swim on water.

It is found generally in veins in serpentine.

It occurs in Norway, Saxony, Spain, &c. and in Scotland.

5. MOUNTAIN WOOD.

Bergholz W. Asbeste Ligniforme H. Rock Wood J.

It is generally of a brownish colour and massive, and has CXXIII somewhat the aspect of wood. It is often so hard and compact (106 as to resemble petrified wood. It breaks into long masses in the direction of the fibres, which are sometimes curved, and occasionally are separable with ease. It is opaque, and the fibres are but rarely elastic. It is fusible into a black slag. It is about CCXXVII twice the weight of water. (107

It occurs in the Tyrol with asbestus and other minerals; in Dauphiné, Stiria, and in Maryland, North America.

In Scotland, it occurs in Glen Tilt, Portsoy, and Kildrumie.

CORUNDUM.*

XLIII
20

Perfect Corundum, Common Corundum, and Emery, are included under the head of Corundum.

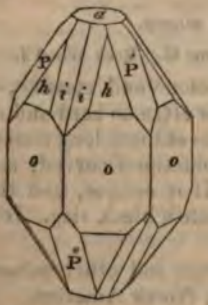
1. PERFECT CORUNDUM.

Saphir W. Corindon hyalin H. Perfect Corundum, Bournon.

XIX
(108)

This consists of two varieties, the sapphire and the oriental ruby. The chief difference between these minerals consists in their colour and hardness. They assume crystalline forms which are derived from the same primary crystal, a slightly acute rhomboid, by the reflective goniometer of 86° 4′ and 93° 56′, in which measurements, brilliant fragments of the sapphire, ruby, and common corundum perfectly agree. Specific gravity 3.975 to 4.161. It possesses double refraction. Alone before the blow-pipe neither the sapphire nor ruby suffers any change whether in fragment or powder; with borax they fuse slowly, but perfectly, into a colourless glass.

Sapphire.† The sapphire is inferior in hardness only to the diamond; it occurs in crystals, mostly in the form of six-sided prisms variously terminated, and also in rolled masses which are colourless, or are of a blue, yellow, or yellowish green colour, and transparent or translucent. By Klaproth's analysis, it consists of 98.5 of alumine, 0.5 of lime, and 1 of oxide of iron; but Chenevix found no lime, and 5.25 of silex. The crystals yield to mechanical division pretty readily in one direction, with a most brilliant surface; but it is extremely difficult to cleave it parallel with the other planes of the primary rhomboid. The cross fracture is conchoidal.



P on P′	86° 4′
P or P′ on *a*	122.27
—— —— *h*	154. 2
h on *h*	128.20
—— *a*	118.56
—— *o*	151.17
o on *o*	120.00

See common Corundum.

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[*] Corundum is the name given to common Corundum by the inhabitants of India.

[†] Sappheiros, Greek; its ancient name.

The sapphire has obtained several names dependent on its colour and lustre. The transparent or translucent, *white sapphire*; the blue, *oriental sapphire*; the violet blue, *oriental amethyst*; yellow, the *oriental topaz*; green, the *oriental emerald*; with pearly reflections, the *chatoyant* or *opalescent sapphire*; when transparent, and with a pale reddish or bluish reflection, *Girasol sapphire*. Some, when cut en cabochon, shew a silvery star of six rays, in a direction perpendicular to the axis; this variety is termed *Asteria*.

Oriental Ruby.[*] The true colour of this variety is a blood red, it is occasionally rose red, or has a tinge of violet. It is more readily cleaved than the sapphire, and is not so hard. It is sometimes chatoyant. It occasionally shews an intermixture of blue; and chiefly occurs in the general form of six-sided prisms. It consists, according to Chenevix, of 90 of alumine, 7 of silex, and 1.2 of oxide of iron.

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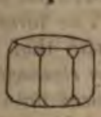

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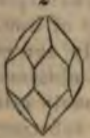

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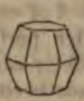
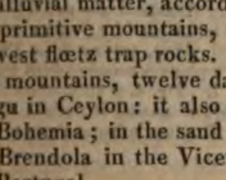


For an illustration of the passage of the primary rhomboid into a six-sided prism, see Corundum. In fig. 1 & 2 the alternate triangular planes are the small remains of the primary rhomboid; the alternate planes of fig. 3 are also those of the rhomboid.



P on P′	86° 4′
P or P′ on *a*	122.30
—— —— *o*	137.30
p on *o*	151.30
—— *a*	118.30
a on *o*	90.00
p on P or *p* on P′.	154. 7

The perfect corundum is found in the sand of brooks and in alluvial matter, according to Brongniart, in the vicinity of primitive mountains, but according to Jameson in the newest flœtz trap rocks. The finest are found in the Capelan mountains, twelve days journey from Sirian, a city of Pegu in Ceylon: it also occurs near Billin and Meronitz in Bohemia; in the sand of the brook Expailly in France; at Brendola in the Vicentine, on Mont St. Gothard, and in Portugal.

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[*] Ruby, from the Latin, ruber, red.

Next to the diamond, the sapphire and oriental ruby are the most valuable of precious stones. The last is the most highly prized; next the blue, the yellow, &c.

tIV
21

2. COMMON CORUNDUM.

Korund W. Corindon harmophane opaque H.

Common corundum, probably from its texture, has received the name of *imperfect* corundum; and from its hardness, or from its occasional peculiar lustre, that of *Adamantine Spar*. It is sometimes nearly colourless, and somewhat translucent; but more often has a greyish or greenish tint, occasionally reddish or red; also brown, with a metallic chatoyant lustre; it is more rarely blue, or yellow and transparent, or black and opaque. The common form of its crystal is the hexahedral prism, which rarely shews a tendency to flatish triedral terminations; it occurs also in obtuse, and in acute, hexahedral pyramids. It is also found granular or compact. That of Malabar consists, according to Chenevix, of 86.5 per cent. of alumine, 7 of silex, and 4 of oxide of iron. The form of the primary rhomboid, which perfectly agrees with that of sapphire and the ruby, is pretty easily obtained by cleavage, because some foreign substance is commonly interposed between the laminæ. Before the blow-pipe this substance yields the same effects as the sapphire and ruby.

Granular corundum has the general appearance of a rough jasper of a purplish colour; but it consists of grains, here and there of a rose colour, closely associated with fibrolite; it is described by Bournon as compact corundum.

1 2 3 4 5

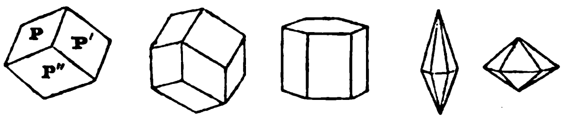
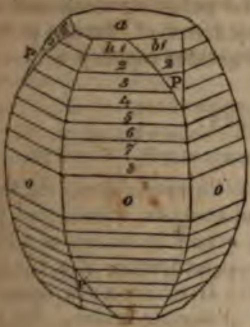


Fig. 1. is the primary rhomboid. Fig. 2. represents a rare variety, in which all the lateral edges of the primary rhomboid are deeply replaced by planes, tending to a six-sided prism, but terminated by portions of the planes of that rhomboid. Fig. 3. is a six-sided prism, arising from the complete replacement of the summits of fig. 2, by a plane connected with the planes of fig. 2, replacing the lateral edges of fig. 1. Fig. 4. a very acute double six-sided pyramid; of acute pyramids there are several varieties; as well as of very obtuse six-sided pyramids fig. 5. The two latter are rarely found presenting both pyramids.



P on P	86° 4′	
P or P on P′	93.56	
o on o	120,00	
a on o	90,00	
P on a	122.50	
b 1 on b 1	130.00	c g
b 2 on b 2	114.00	..
h 1 on h 1 over a	58.00	..
2 — 2 ——	50.00	..
3 — 3 ——	40.00	..
4 — 4 ——	35.00	..
5 — 5 ——	30.00	..
6 — 6 ——	24.00	..
7 — 7 ——	20.00	..
8 — 8 ——	12.00	..

The planes *o o o* in conjunction with *a* tend to the production of a regular six-sided prism.

——— *b* 1 & *b* 2 to obtuse rhomboids, by planes situated on those of the primary rhomboid, and inclining on its summit. See remarks on the secondary crystals derived from the rhomboid. Art. *Calcareous Spar.*

——— *h* 1—8 to double six-sided pyramids with triangular planes; they do not however occur as above represented on the same crystal, but on separate crystals, first noticed and measured by Bournon by the common goniometer, and which I have since verified by means of crystals in my own possession.

Common corundum is found in India in a granite rock, imbedded, after the manner of felspar. It is often accompanied by the fibrolite, talc, garnet, zircon, and magnetic iron. It is also found in China, nearly under the same circumstances. It occurs every where from China to Bengal; in the kingdom of Ava, and on the coast of Malabar: its gangue, in the Carnatic, is a coarse-grained white marble, or the Indianite. The corundum of China and Ava, is either brown, or green of various shades, but that of China is sometimes black; the yellow is found in Bengal; that of the Carnatic, is blue, or red inclining to purple, but the prevailing colours are greenish white, or pale green with a yellowish tint; it is usually rough on the surface, and generally more or less impregnated with fine particles of its matrix, the Indianite, but is semi-trsnsparent when broken. That of China and Malabar is rough on the surface, and is sometimes chatoyant, and is imbedded in granite; the Malabar sometimes shews concentric hexagons, which are chatoyant when polished. That of Thibet is sometimes coated by green steatite, and is usually of a red brown colour. It has been found in Piedmont in compact felspar and in calcareous spar; in Sweden in magnetic iron. ExLV 22

In the East Indies it is used for polishing steel, and cutti and polishing gems; but the lapidaries of Europe prefer di mond-powder, on account of the greater rapidity with which works.

3. EMERY.

Schmiergel W. Corindon granulaire H. Emeril Bt.

Emery, though it bears very little resemblance to the pr ceding, is, from its hardness and analysis, considered to be variety of corundum. It usually occurs in masses of a blacki or bluish grey colour, having the aspect rather of a fine grain rock, than of a simple mineral. It occurs both massive ar disseminated, with a somewhat glistening lustre. Its specil gravity is 3.66. That of Naxos consists, according to Tennar of 86.5 alumine, 3 of silex, and 4 of oxide of iron.

It is found in the East Indies, enclosing whitish or reddi talc, and small portions of magnetic iron. That of Smyrna micaceous; and encloses magnetic iron and sulphuret of iro In the isle of Naxos, emery is found in rounded masses at tl foot of primitive mountains. It occurs in Italy and in Spai but that of Ochsenkopf, near Swartzenberg in Saxony, seer to be the only variety which has been seen in its native plac It is disseminated, according to Brochant, in a bed of ha steatite, of a yellowish grey or apple green colour, mixed wi common talc, or according to Jameson in clay-slate.

It is said to have been found in Guernsey and Jersey, b Dr. Mac Culloch says in his account of these islands, that l neither discovered it, nor could learn that it ever had be found in them.

In the east of Ireland sparingly in a ravine in Glenmalı Wicklow.

DIASPORE.

Diaspore H. Bt.

Diaspore is yet a scarce mineral. It has been found in a ma consisting of slightly curvilinear laminæ of a shining pear lustre and greenish grey colour, and which may be readily s parated; also in cellular masses constituted of slender cryst and a pearly lustre, intercepting each other in every dire tion, of a brown colour externally, but perfectly transpare and colourless when reduced to thin laminæ; rarely also separate crystals, in the form of a doubly oblique prism. I exposure to the heat of a candle, it crackles and is *dispersed*[*]

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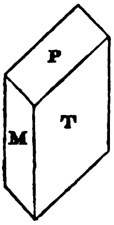
[*] Whence Diaspore; from the Greek, in allusion to this property.

minute fragments with a brisk decrepitation. It scratches glass; its specific gravity is 3.43; and it consists of 80 per cent. of alumine, 0.3 of iron, and 17 of water, according to Vauquelin. The brown variety consists, according to J. G. Children, of alumine 76.06, protoxide of iron, 7.78. water 14.70—loss 1.46. Exposed to heat in a matrass it decrepitates violently, and splits into small white brilliant scales, which, before the blow-pipe with borax fuse readily into a colourless glass.



M on T 64.54
P on T 101.20
P on M 108.30

Nothing is known of its geological situation.

GIBBSITE. Torrey.

Gibbsite, Cleaveland.

It is described as commonly occurring in irregular stalactites from one to three inches in length, and not less than an inch in diameter, and presenting an aggregation of elongated, tuberous masses, parallel and united. Sometimes it appears in larger tuberous masses. Its structure is indistinctly fibrous, the fibres radiating from the center. It is a little harder than calcareous spar, but is easily reduced to powder: is slightly translucent, and has but little lustre. It is of a dirty white colour, greenish or greyish. Specific gravity 2.40. Analysis by Torrey, and also by Dewey, alumine 64.8, water 34.7. Before the blow-pipe it whitens but is infusible.

It is found at Richmond in Massachusets, N. America, in a neglected mine of brown hæmatite iron ore.

CALAITE. ORIENTAL TURQUOISE.

Calaite, Fischer. Odontalite.

It occurs in reniform masses, which are either botryoidal or mamillated, and from the size of a nut to that of a goose's egg. & XCI XCII It is of a peculiar greenish blue colour, but of various shades, passing on the one hand into sky blue, and the other into apple green. It is dull internally, but occasionally the lustre is waxy, rarely splendent. The fracture is subconchoidal in the mamillated specimens, conchoidal in the blue; sometimes

rough and uneven, occasionally scaly. It is commonly o
rarely a little transparent on the edges. It is not so h
quartz; yielding to the knife a white powder. The w
decomposed specimens greatly resemble porcelain clay.
cific gravity 2·7 to 3.2. Before the blow-pipe it does no
but assumes a vitreous appearance; with borax it melts r
into a limpid glass.

It is, according to Dr. Fischer, clay, coloured by ox
copper, or even by arseniate of iron: analysis by M.
alumine 73, oxide of copper 4.5, oxide of iron 4, wat
lead and loss 0.5.

The *oriental calaite* is found in alluvial clay in the
bourhood of Nichabouri in the Korasan; according to
nier, there were two mines of it in Persia. Fischer has
the names of *Agaphite* and *Johnite* to varieties of this mi
the latter is said to have been found in siliceous slate.

The *occidental turquoise* is found near the town of S
in Lower Languedoc. It is said that the horn or to
subjected to heat in order to produce the colour. Analy
Bouillon La Grange, phosphate of lime 80, carbonate o
8, phosphate of iron 2, phosphate of magnesia 2, alumin
water 1.6.

FIBROLITE.

Fibrolite. Bournon.

CVI
24
The Fibrolite is white, or of a dingy grey colour;
fibrous,* and rather harder than quartz, giving sparks
the steel. The fibres are rarely so large as to present an
determinate form, and are obliquely traversed by cracks
the Count de Bournon describes some in that of a right
with rhombic bases, of which the angles are 100° an
The fibrolite is infusible; its specific gravity is about
it is composed of 58 of alumine and 38 of silex, by the a
of Chenevix. According to Haüy, it acquires a sensible re
electricity by friction, and according to Bournon, it e
phosphoric light when two pieces are rubbed together.

It is found accompanying crystals of corundum in th
natic, and as a component part of the granite which
matrix of that of China.

PINITE.

Pinit W. Pinite H.

CCLXXXIV The Pinite occurs in six-sided, or in twelve-sided p
(109) of which the lateral, and more rarely the terminal edg

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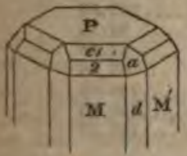
* Whence Fibrolite.

sometimes replaced, as in the following figure, but it does not appear in the general to possess any regular structure; one crystal from the Puy de Dome, yielded to mechanical division parallel to the terminal planes of the six-sided prism, which is considered to be the primary crystal. It is of a brown, blackish brown, or grey colour, and opaque, being often somewhat ochreous externally. It yields to the knife easily; its specific gravity is 2.98. It is infusible. By the analysis of Klaproth, it consists of 63.75 alumine, 25.9 silex, 6.75 oxide of iron. Before the blow-pipe, on charcoal, it whitens and fuses on the edges into a white blebby glass; the most ferruginous sometimes fuse readily into a black glass.



M on M......	120	*c g*
P on M or M′..	90	..
P on c1......	150	..
......2......	131	..
......*a*......	120	..
M or M′ on *d*..	150	..

It was first discovered in granite, near Schneeberg in Saxony, in the mine called Pini:* it has since been found in the Puy de Dome in France, in a porphyritic felspar; at Haddam in Connecticut, North America, in a micaceous rock; at Arendahl in Norway, in mica.

In Britain it is said to have been found imbedded in the granite of St. Michael's Mount in Cornwall, and in Ben Gloe, Blair-Gowrie, and Glen Tilt, in porphyry.

KYANITE. CYANITE.

Kyanit W. Disthène H.

This mineral occurs in four or eight-sided prisms which mostly are terminated irregularly; sometimes two or more flat crystals adhere together by their broad surfaces. The primary form is a doubly oblique prism, of which the terminations are nearly rhombs. The crystals yield to mechanical division parallel to all the planes of that solid, with difficulty parallel to those which may be considered as the terminal. The angles of the prism are 106° 15′ and 73° 45′; of the terminal plane on the prism, in one direction 100° 50′ and 79° 10′, and in the other 93° 15′ and 86° 45′, by the reflective goniometer from the planes of cleavage. Its colours are white, grey, and blue;†

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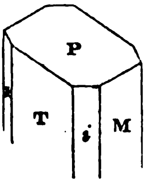
* Whence Pinite.

† Whence Kyanite from the Greek, signifying blue.

it has sometimes a greenish tinge: the grey and blue are often intermixed in the same crystal; it has a pearly lustre; the edges of the crystals scratch glass, but the broad surfaces yield to glass. It is infusible. Some crystals by rubbing acquire negative electricity, others positive.[*] By the analysis of Klaproth, it consists of 55.5 alumine, 38.5 silex, 0.5 oxide of iron. Analysis of that of St. Gothard, by Arfwedson, alumine 64.89, silex 34.33: that of Norway he found to consist of about 2 parts more of the former, and 2 less of the latter. Before the blow-pipe even its powder is infusible, with borax it fuses slowly into a transparent colourless glass.



M on T....106° 15′
P on M....100.50
..... T.... 93.15
..... i 97.48
..... k 83.38
M on i 145.16
T on i 140.55
..... k 122.20

It has been found only in primitive rocks. In St. Gothard, it occurs in mica slate, with garnet, grenatite and quartz; in the Sualp in Carinthia, with garnet, actynolite, &c.; in the Tyrol with quartz and hornblende; it also occurs in France, Hungary, Spain, &c. and in several places in the United States of North America in very large crystals, in primitive rocks, chiefly micaceous.

A variety which is nearly white or somewhat reddish, in aggregated crystalline masses, has been termed the *Rhœtizite*. It is from Pffitch in the Tyrol.

In Scotland, it occurs at Botrifay in Banffshire in a vein of quartz traversing a talcose clay slate; in primitive rocks near Banchory in Aberdeenshire; in mica-slate in Mainland, Shetland. In Carnlia one of the summits of Ben-y-gloe, and in Glen Tilt imbedded in quartz.

IX
25

STAUROLITE. GRENATITE.[†]

Grenatit W. Staurotide H.

XXX
26

The Staurolite is of a reddish brown colour, and occurs sometimes in rhombic prisms, of which the acute edges are more often replaced, thus converting them into six-sided prisms. The crystals often intersect and cross each other at particular angles, and are then superficially of a dull brown: the primary crystal is a right rhombic prism of 129° 20′ and 50° 40′, by the reflective goniometer; it is divisible parallel to its sides and diagonals, the latter with the greatest brilliancy. The Staurolite is sometimes opaque, sometimes translucent; has a vitreous or resinous lustre; is of about the hardness of quartz, and is infusible. Its specific gravity is about 3.30; that of St. Gothard is composed by Klaproth's analysis of 52.25 of alumine, 27 of silex, 18.5 of oxide of iron, and 0.25 of oxide of manganese.

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[*] Hence the name Disthène was given by Haüy to this mineral, on account of its double electrical powers.

[†] Staurolite from the Greek signifying a cross stone.—Grenatite, in allusion to its (occasional) garnet colour.

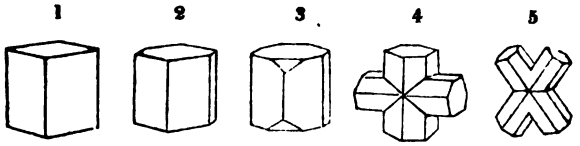
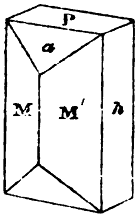


Fig. 1. The primary form; a right rhombic prism. Fig. 2 the same, of which the acute edges are replaced by planes, forming a six-sided crystal. Fig. 3 differs only from fig. 2, in having the obtuse solid angles replaced by triangular planes. Fig. 4, a macle, consisting of two crystals resembling fig. 2, crossing each other at right angles. Fig. 5, a macle, in which the crystals cross each other at a different angle.



M on M′......129°.20′

P on M or M′. 90. —

M or M′ on *a* .137.58

M′ on *h* 115.18

The Staurolite belongs to primitive countries. It has been found in Brittany near Quimper, in a micaceous clay, considered to be the debris of a primitive rock: it occurs also at St. Gothard, imbedded in micaceous schistus; and at St. Jago de Compostella in a primitive rock, and is accompanied by the Kyanite. In several places in the United States in primitive rocks.

In a micaceous compound in Glenmalur lead mines, in Wicklow, Ireland. In the north of Scotland in mica-slate.

AUTOMALITE.

Automalith W. Spinelle zincifère H. Fahlunite. Gahnite. & XI. 2;

The Automalite is by some considered to be a variety of the Spinelle Ruby; and as it contains a considerable proportion of & XC - 2 the oxide of zinc, it has obtained the name of the *Zinciferous Spinelle;* sometimes it is called the *Gahnite*, in honour of Gahn, its discoverer. It occurs in regular octohedrons, which may be cleaved parallel with all its planes and in other directions; it also occurs in tetrahedrons of which the angles are replaced, and in macled or hemitrope crystals. It scratches glass. The sp. gr. of the Automalite is 4.26—4.69: it is therefore much heavier than the Spinelle Ruby, from which it also differs in being nearly opaque, and of a dark bluish-green colour by transmitted light, as well as essentially in respect of composition: it consists according to Vauquelin of 42 parts of alumine, 4 of silex, 28 of oxide of zinc, 5 of oxide of iron, and 17 of sulphur. Before the blow-pipe it is unalterable alone; with borax, it fuses in very small quantity even in powder. Some mineralogists have concluded that the Automalite is the Pleonaste loaded with sulphuret of zinc; which amounts to an acknowledgement that it is essentially a different substance; and therefore it ought not to be considered, any more than the Pleonaste, as a variety of the Spinelle Ruby.

It is found in a talcose rock at Fahlun in Sweden, whence it has been called the *Fahlunite*; a name which has also been given to *Tricklasite* and some other minerals. It has since been found at the Franklin iron works, Sussex county, New Jersey, North America, accompanied by quartz, felspar, and Jeffersonite.

TOPAZ*

Topaz W. Silice fluatée alumineuse H.

The Topaz is found massive, in rounded pieces, and crystallized: its general form is prismatic, and it is variously and dissimilarly terminated: the prism is usually striated longitudi-
CIXIII nally and modified. Its structure is lamellar at right angles to the axis of the prism; it also cleaves, though with difficulty,
(111) parallel to the sides of a right rhombic prism of about 124° 22′ and 55° 38′ by the reflective goniometer; and it appears to yield to mechanical division on all the angles of the prism: its cross fracture is conchoidal with a shining vitreous lustre. It is sometimes limpid and nearly transparent, or of various shades of yellow, green, blue, lilac, or of red, and translucent. It mostly becomes electric by heat, with polarity; it exhibits a double refraction; its specific gravity is 3.5; it scratches quartz. The white Brazilian topaz consists, according to Vauquelin, of 50 per cent. of alumine, 29 of silex, and 19 of

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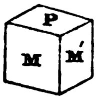
* The name of the island whence this mineral was procured by the ancients.

fluoric acid: those of a yellow colour occasionally yield a small portion of oxide of iron. As the proportion of fluoric acid varies in the topaz, according to different analyses, from 4 to 19 per cent. this substance cannot strictly be arranged among acidiferous minerals.

The pale greenish and almost transparent topaz of Siberia becomes electric by being heated, not by being rubbed: the Saxon topazes, of a pale yellow colour, become electric by friction, not by heat; but lose their colour by being subjected to fire; the deep yellow topazes of Brazil, become electric by heat, and red by being placed in the fire. Before the blowpipe on charcoal the topaz does not fuse; with borax melts slowly into a transparent glass.

1



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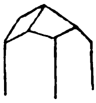

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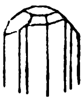
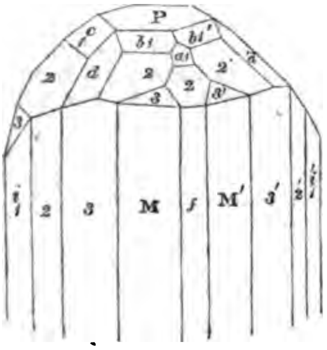


Fig. 1. The primary; a right rhombic prism. Fig. 2. the same, terminated by four planes; of which two replace the acute solid angles, and the other two the obtuse solid angles. In fig. 3 each acute solid angle is replaced by one plane, and each obtuse solid angle by two planes, leaving apparent a portion of the flat summit of the primary prism: there are several modifying planes on the prism itself. The crystals are rarely pyramidal at both ends; when they are so, the terminations are dissimilar.



M on M′	124°22′	H
P on M or M′ ..	90.00	..
—— *b* 1	124.36	..
—— *b* 2	135.59	..
M on *i* 1	150. 6	..
—— *i* 2	161.16	..
—— *i* 3	169.34	
P on *c* 1	128.26	H
—— *c* 2........	135.59	..
—— *c* 3.	117.21	..
—— *d*	138.26	..
—— *b* 1........	145.24	..
—— *b* 2........	134. 1	..
b 2 on *b* 2........	140.46	..
b 2 on *b* 3........	162.00	
b 3 on *i* 2........	148.22	
a 1 on *f*	134.00	
f on *i* 2	122.17	H
c 2 on *c* 2 over P..	92.45	
d on *i* 2	131.34	H
b 3 on *a* 2........	155.20	

The Topaz is found almost exclusively in primitive countries of the oldest formation; chiefly in tin veins traversing granite; in which it is sometimes found imbedded.

It occurs in the tin veins of Schlackenwald in Bohemia, accompanying tin, fluate of lime, and mispickel. In the valley of Danneberg in Saxony, the topaz is imbedded in a rock together with quartz, black schorl, mica, and lithomarge, forming an aggregate which has obtained the name of *Topaz Rock*. In the Uralian mountains, topazes are found in graphic granite: in Brazil, they occur imbedded in an argillaceous earth, resulting, as it is believed, from the decomposition of primitive rocks. In
XIII Silesia and Salzburg it has been found in clay-slate: at Eibens-
tock in Savoy in alluvial soil. It is found also in Siberia, North
112) and South America, &c.

In Cornwall, the topaz is found in small, whitish or greenish crystals, both translucent and opaque, in veins in granite at St. Michael's Mount, accompanying tin, apatite, felspar, and it is said also the pinite; in tin veins in clay-slate, of a yellow colour, both crystallized and massive. In Huel Kind near St. Agness with phosphate and carbonate of iron. In Scotland, in alluvial soil at Cairn-goram Aberdeenshire; at Ben-avon in Mar.

1. PYROPHYSALITE. PHYSALITE.

Pyrophysalith. Hisinger.

CX The Pyrophysalite is considered to be a variety of the topaz,
29 and has been found in crystals of considerable dimension, and resembling that mineral in form. It also occurs in roundish masses, which are externally dull and smooth: its structure is lamellar in one direction, and splendent; the cross fracture is glimmering and uneven. It is translucent on the edges, and not so hard as quartz. Its specific gravity is 3.41. It consists of the same ingredients as the topaz, and with very little variation of relative quantity, according to Berzelius. It is of a greenish white, or pale bluish green colour: by heat it intumesces,* and gives out a greenish phosphoric light.

It is found at Fahlun and Finbo in Sweden, in round masses, in a granite composed of white quartz, of felspar, and silvery white mica; from which these masses are separated by talc of a greenish yellow colour.

SILICIFEROUS HYDRATE OF ALUMINE.

It is described as being opaque and white, or slightly tinged by yellow or green. It is soft; when dry, owing to exposure, the fracture is resinous, and it then absorbs about one-eighth of its weight of water. It scarcely scratches calcareous spar, and adheres to the tongue. By exposure to heat it becomes friable and light, and loses 40 per cent.; and is infusible before the blow-pipe. When acted on by acids, it assumes a gelatinous appearance. Analysis by Berthier, alumine 44.5, silex in combination 15, water 40.5.

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* Whence Pyrophysalite, from the Greek, in allusion to the effect of heat on it.

It was found by M. Lelievre in the gallery of a lead mine, on the bank of the river Oo, in the Pyrenees.

1. SEVERITE.

It occurs in small masses of a fine white, without lustre, but possessing a slight degree of translucency; occasionally it is semi-transparent. It is a little harder than lithomarge, which it somewhat resembles. The surfaces produced by fracture are dull; it is extremely brittle, and yields easily to the knife; it is soft, but receives a high polish by friction; adheres strongly to the tongue, but has no argillaceous odour when breathed on. It does not effervesce with acids, nor form a paste with water. Its colour does not change by exposure to heat, and it has been said to diffuse a scent like that of apples, particularly when newly fractured. Analysis by Pelletier, silex 50, alumine 22, water 26, loss 2.

It was found by M. Dufour in the neighbourhood of St. Sever* in France, in a gravelly soil, in small masses from two to four or five inches in diameter.

2. LENZINITE.†

Johns.

It has been divided into two varieties, the Opaline and the Argillaceous, which are described as follows:

E.C.L. 111
30

(*a*) *Opaline.*

It is of a milk-white colour; it occurs in pieces of various sizes, mostly small; to the touch it is smooth and slightly greasy; its surface is not shining. Its fracture is large and flat conchoidal, its fragments are of an indeterminate form; it is transparent, completely so on the edges; it is moderately hard, and is sectile. It is easily reduced to a white powder. It adheres to the tongue. Its specific gravity is 2.10. Placed in water, it divides with noise, into a multitude of pieces, which are nearly transparent, and which on the slightest touch fall into innumerable small and hard grains. Exposed in a crucible to a red heat, it loses 25 per cent. of water, and becomes hard enough to scratch glass. It consists of 37.50 of silex, 37.50 of alumine, 25 of water, and a trace of lime. Johns.

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* Whence Severite.

† Named in honor of Lenzius, a German mineralogist.

(*b*) *Argillaceous.*

Its common colour is snow white, but is occasionally tinged yellow by oxide of iron; it is dull, its fracture is earthy, and its fragments are of an indeterminate form. In minute pieces only it is slightly translucent; by rubbing or scratching it becomes shining and unctuous; its parts cohere but slightly, and it strongly adheres to the tongue; its powder is snow white. Its specific gravity is 1.80. Placed in water it breaks down with much sediment, but less than that of the opaline, without increasing its transparency. Exposed to a red heat, it becomes hard enough to scratch glass; but undergoes no other change. It consists of silex 39, alumine 35.5, water 25.0, lime 0.05. Johns. Both varieties occur at Kall in Eifeld.

3. KOLLYRITE.

Kollyrite Br. Lucas.

This substance occurs under the appearance of a white clay of considerable tenacity, from which water may be expelled by pressure; and it retains water so strongly, as to require more than a month to become dry, even in small masses: it separates by desiccation into the columnar form, like starch, losing half its weight, and becoming very light. It absorbs water with a hissing noise, and becomes semi-transparent either wholly or in part. Analysis by Klaproth, alumine 45, silex 14, water about 40. It is absolutely infusible, and dissolves without effervescence in nitric acid.

It was found by Friesleben at Weissenfels in Thuringia, filling up a vein in sandstone. Townson observed it in the mines of Schemnitz in Hungary.

4. ALLOPHANE.*

Allophane Stromeyer.

This mineral occurs in colourless and semi-transparent masses, possessing a somewhat vitreous lustre. It is also described as occurring blue, green, and brown: it is extremely brittle, but may occasionally be cleaved into prisms which apparently

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31

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[*] From the Greek; in allusion to its occasional resemblance to another mineral.

are rectangular; the specific gravity is 1.85. Analysis by Stromeyer, alumine 32.20, silex 29.92, water 41.30, carbonate of copper 3.05, lime, sulphate of lime, and hydrate of iron, a trace: the presence of carbonate of copper leads to the conclusion that the foregoing analysis was of one of the coloured varieties. Before the blow-pipe it intumesces without fusing, and readily falls into powder; with borax it fuses readily into a colourless glass.

It occurs in a bed of limestone subordinate to greywacke in Thuringia. A substance much resembling Allophane has lately been found in Derbyshire.

PYCNITE. SCHORLACEOUS BERYL.

Schorlartiger Beryl W. Var. de silice fluatée alumineuse H.

The Pycnite is only found in long six-sided prisms which are deeply striated longitudinally; the prisms are often closely §XXXVII
aggregated [*] laterally, and exhibit transverse rents, but do not 32
appear to possess a regular structure. It is usually of a dull yellowish or reddish white colour, and translucent; it is brittle and may be readily broken across the prism, but its fracture in other directions is imperfectly conchoidal, with a shining lustre: it scratches quartz: its specific gravity is 3.5. It is composed according to Vauquelin, of 60 per cent. of alumine, 30 of silex, 2 of lime, 6 of fluoric acid, and 1 of water: but according to a newer analysis of Berzelius it consists only of alumine, silex, and fluoric acid. Before the blow-pipe on charcoal it does not fuse; with borax it melts slowly into a transparent glass; it becomes electric by exposure to heat.

It is found entering into the composition of a rock, chiefly consisting of quartz and mica, at Altenberg in Saxony: it is said also to have been met with in Bavaria: at Schlackenwald in Bohemia, it is imbedded in an aggregate of quartz, tin, wolfram, and molybdena. In France, at Mauleon, in steatite. In Siberia it accompanies mica and quartz. At Kongsberg in Norway in mica-slate.

CHRYSOBERYL.[†]

Krysoberyll W. Cymophane H. Bt. Chrysoberil Br.

This substance occurs in semi-transparent rounded pieces, massive, and crystallized; it is of a green colour, sometimes § LI
33

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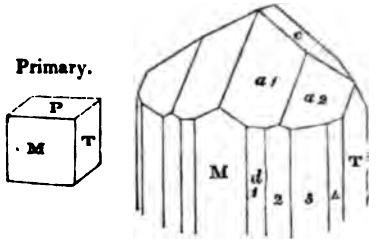
[*] Whence Pycnite from the Greek; signifying closely aggregated.

[†] Chrysoberil, from the Greek, signifying a superior kind of beryl. Cymophane from the same, signifying a floating light, in allusion to its opalescence.

with a yellowish or brownish tinge, and occasionally shews an opalescing bluish white light internally. The primary form of its crystal is a right rectangular prism. The crystals yield to mechanical division readily and with brilliant surfaces parallel to the plane M of the following figures, and with difficulty also parallel to the plane T, and to the longer diagonal of the prism; the cross fracture is perfectly conchoidal with a splendent resino-vitreous lustre; it scratches quartz. Its specific gravity is about 3.8. It becomes electric by friction. That of Brazil is composed of 71.5 per cent. of alumine, 18 of silex, 6 of lime, and 1.5 of oxide of iron. It is sometimes called the *Oriental* or *Opalescent Chrysolite.* Before the blow-pipe it suffers no change, alone; with borax it fuses slowly into a transparent glass.



M on T		90°00′	
——	*d* 1	154.51	
——	*d* 2	136.20	
——	*d* 3	125.18	
——	*d* 4	120.55	
——	*a* 1	137. 6	
——	*a* 2	128.43	H
a 1 on	*c*	133.19	..
T on	*a* 1	110. 3	..
——	*a* 2	126. 8	..
a 1 on	*a* 2	163.53	

It is chiefly procured from Brazil, where it is found accompanying topazes; it has been noticed in the sand of the rivers of Ceylon, together with rubies and sapphires: a few specimens have been brought from Nerbschink in Siberia. Its geological situation in the above countries is not known. At Haddam in Connecticut, North America, it is said to occur in granite, in six-sided tables and prisms, with garnet, emerald, &c.

SPINELLE RUBY.

Spinell W. Spinelle H.

LIV 34 The Spinelle Ruby is found in grains, more commonly crystallized, either in the form of its primary, the regular octohedron, or its variety an acute rhomboid, or of the octohedron having the edges replaced, and occasionally in macles presenting very different forms. It is of various shades of red, violet, or yellow; more rarely black. Its structure is lamellar, though not very distinctly so; but it appears to yield to mechanical division in several directions, which however have not been precisely ascertained. Its fracture is commonly flat conchoidal, with a splendent vitreous lustre. It scratches quartz easily, but is not so hard as the oriental ruby, from which it is readily distinguished both by its colour and crystallization. It is infusible: its specific gravity is 3.7; and it consists according to Vauquelin of 84.47 alumine, 8.78 magnesia, 6.18 of chromic acid. Its colour is supposed to be owing to the acid, which differs in its proportion in various analyses; but is never sufficiently great for the arrangement of the spinelle among acidiferous minerals.

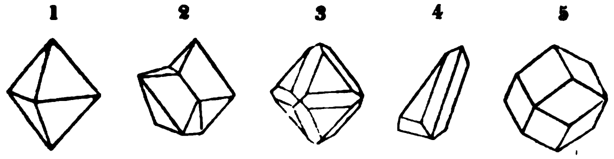
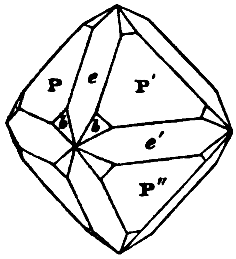


Fig. 1. The primary; the regular octohedron. Fig. 2. a macled crystal, in such a position as shews it to be composed of about equal parts of an octohedron (fig. 1.), of which one half is half turned round. Fig. 3. the octohedron with its edges replaced. Fig. 4. a macle consisting of two equal and similar portions of a crystal resembling fig. 3; being sections, parallel with two opposite primary planes, placed base to base. Fig. 5. the rhombic dodecahedron, resulting from the replacement of all the edges of the octohedron, by planes similar to those of fig. 3, but deeper.



P on P′ or P′ on P″	109°28′ 16″ H
P or P′ on *e*, or P′ or P″ on *é*	144.44. 8 ..
b on *b*	129.31.16 ..
b on P or *b* on P′	150.20.00

Like the greater number of the gems, the geological situation of the Spinelle Ruby is not accurately known. It sometimes occurs with sapphires and oriental rubies in the sand of rivers: as in that of the rivers of Ceylon. In a specimen from India now in the British Museum, it is imbedded in a lamellar carbonate of lime, enclosing red mica, sulphuret of iron, and phosphated lime; it has also been found in a substance greatly resembling adularia; and in the cavities of limestone ejected from Vesuvius along with vesuvian and ceylanite.

The scarlet coloured is properly termed the *Spinelle Ruby;* the rose red, the *Balas Ruby*: the yellow or orange red, the *Rubicelle*; the violet coloured, the *Almandine Ruby.*

PLEONASTE.*

Zeylanite W. Pleonaste H. Ceylanite J.

The Pleonaste is commonly considered to be a variety of the Spinelle Ruby; but, it is less hard, a little heavier, and differs from it both in colour and in composition. Its specific gravity is about 3.8. That of Oker, according to Berzelius, is composed of 72.25 of alumine, 5.48 of silex, 14.63 of magnesia, and 4.26 of protoxide of iron. In general colour it also differs from the Ruby: the Pleonaste appears nearly black: but when placed between the eye and the light, it is translucent, and green or blue. Some however are said to have been brought from Ceylon of a sky-blue, others of a yellowish colour. It occurs in crystals, of which the primary is considered to be the regular octohedron. The cross fracture is flat conchoidal; the lustre, splendent, resinous: it scratches quartz, but is not so hard as the spinelle. Before the blow-pipe, alone, it suffers no change; with borax it fuses into a dark green transparent glass.

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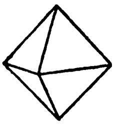

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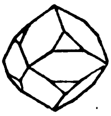

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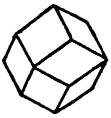
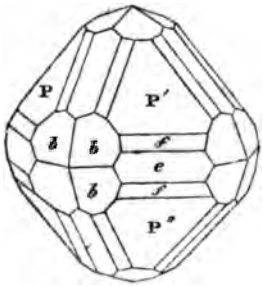


Fig. 1. The primary octohedron. Fig. 2. the same of which the edges are deeply replaced; the triangular planes being portions of the primary octohedron. This shews the passage of the octohedron into the rhombic dodecahedron, Fig. 3.



P on P′ or P′ on P″..	109°.28′.16″	H
P′ or P″ on *e*	144 .44 . 8	H
P′ on *f* or P″ on *f*	157 .50	
e on *f* or *f*′	166 .36	
b on *b*..............	144 .54 .10	H
b on P′ or *b* on P″....	150 .25	

The geological situation of the Pleonaste differs for the most part from that of the Spinelle Ruby. The Pleonaste is found, accompanied by tourmalines, &c. in the rivers and alluvial country of Ceylon. It has often been found in the cavities of the lavas of Vesuvius, and of Somma. It is also met with in the volcanic rocks of Somma, both calcareous and granitic; E.VII and in those of Laach, near Andernach, on the banks of the Rhine. 35 The *Blue Spinelle* of Andernach crystallises in the form of the regular octohedron, which may be cleaved parallel to its planes. It also occurs at Munzoni in the Tyrol.

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* Pleonaste from the Greek, signifying—which superabounds; in allusion to the four facets (*b*) sometimes found on each solid angle of the octohedron.

IOLITE.* DICHROITE.

Iolite H. Dichroïte, Cordier. Cordierite, Leonhard.

This mineral is of a purplish or bluish violet colour, sometimes with a tinge of black; but when viewed by transmitted E.LXXXV light at right angles to the axis of the prism, the colour of this 36 mineral appears brownish yellow. It occurs massive, and also, it is said, crystallized in six or twelve-sided prisms, and is described as possessing natural joints parallel with all the planes of a six-sided prism. It is sometimes opaque, sometimes translucent. It has a shining vitreous lustre; an uneven or somewhat conchoidal fracture, and is so hard as to scratch quartz. Its specific gravity is 2.56. It has been lately analysed by Gmelin, who found it to be composed of silex 42.6, alumine 34.4, lime 1.7, magnesia 5.8, oxide of iron 1.5, oxide of manganese 1.7. Alone, before the blow-pipe, in a strong heat, the edges fuse into a blue glass; with borax it fuses slowly into a diaphanous glass.

It is said to have been found at Cape de Gate in Spain: in Granada in the same country in two places, viz. at Granatillo, disseminated in a blue clay contained in greenstone, and in the bay of St. Pedro in lava. It has lately been found in primitive trap at Arendahl in Norway.

1. PELIUM, OR PELIOME.†

This mineral exhibits so completely all the characters of iolite that it can scarcely be said to be a variety of it. In form, fracture and hardness they perfectly agree. Sp. gravity of pelium 2.714. Analysis by Dr. Brandes, silex 54.00, alumine 28.50, magnesia 0.50, protoxide of iron 16.18, oxide of manganese 0.25, water 0.25.

It occurs at Bodemnais in Bavaria in grey granite.

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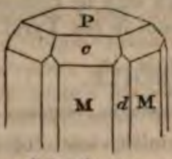
[*] Iolite from its bluish violet colour in one direction: dichroite from two Greek words signifying of two colours.

[†] From the Greek, signifying bluish colour or blackish.

2. STEINHEILITE.*

This mineral also seems to be identical with dichroite. Its colour is either light or Berlin blue; sometimes, though rarely, it is nearly colourless. Analysis by Von Bonsdorff, silex 49.95, alumine 32.28, magnesia 10.45, peroxide of iron, 5.00, oxide of manganese 0.03, volatile matter 1.65.



P on M or M	90°00′
M on M............	120 00
M or M on *d*	150 00
M on c.............	137 46

It is found in the copper mine of Orrijarvi in Finland.

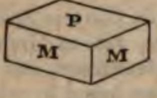
LAZULITE.† AZURITE.

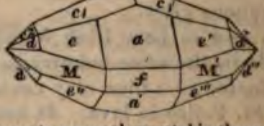
Lazulit W. H. Azurite J.

XIV
37

The Lazulite is rarely found in perfect crystals of a fine blue colour of different shades; it is more often granular, or in pieces not exceeding the size of a hazel nut: it is somewhat translucent, brittle, yet nearly as hard as quartz; the fracture is lamellar, but the direction of its cleavages have not been determined: its primary form is a right rhombic prism. Analysis, alumine 66, It is composed of alumine 66, silex 10, lime 2, magnesia 18, of oxide of iron 2.5: Tromsdorf.

Primary.





The second of the above figures represents a superb crystal in the possession of H. J. Brooke, Esq.

M on M′......................	121°30′
—— *e* or M′ on *e*′..............	138 45
M on *d*	140 30
M or M′ on *f*	150 45
a on *a*	91 30
—— cl or cl′	129 10
a on *e* or *e*′ or *a*′ on *e*″ or *e*‴	158 10
cl on cl′.......................	120 40
cl on *c*2′ or cl′ on *c*2′	150 0
e on *d*, or *e*′ on *d*′...............	162 36
cl on *e* or cl′ on *e*′	139 25
cl on *d*........................	141 20

It occurs in Vorau in Stiria, in a gangue of quartz, in a vein traversing mica slate; and in Salzburg, in clay-slate.

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* So named after Count Steinheil.

† Lazulite from Azut, the name by which the Arabs designate this mineral.

HYDRATE OF MAGNESIA.

Native Magnesia, Bruce. Hydrate of Magnesia A.

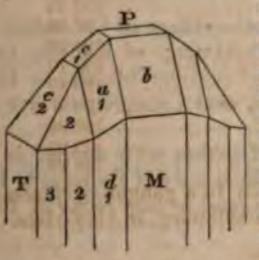
s in plates, which have a laminated structure, and itly disposed in a radiated position. It is described rewster as occurring in regular hexaedral prisms , occasionally with a tinge of green. It is semi- with a somewhat pearly lustre, but becomes opake re; is somewhat elastic, adheres slightly to the l is so soft as to yield to the nail: its specific gravity 63: analysis of the American by Dr. Bruce, magnesia water 30 per cent; of that of Unst by Dr. Fyffe, 69.75, water 30.25. It dissolves entirely in the itric, and dilute sulphuric acids.

neral has been found at Hoboken in New Jersey, rom a few lines to a few inches thick, traversing in every direction: it has lately been found by Dr. t Swinaness in Unst, one of the Shetland Isles, serpentine in all directions, mixed with magnesian of lime, and forming veins from half an inch to six ches thick.

CHRYSOLITE.*

* Krysolith W. Peridot H.

rysolite occurs in angular, or in somewhat rounded masses, or in prismatic crystals variously terminated. nary form is a right prism with rectangular bases, be obtained by cleavages parallel to all its planes, he measurement of 90° every way by the reflective ; the cross fracture is conchoidal with a vitreous s colour is yellow, sometimes tinged with green or is translucent, and possesses double refraction. It lass but is scratched by quartz: its specific gravity is onsists of 50.5 per cent. of magnesia, 38 of silex, oxide of iron, according to the analysis of Vauquelin. ble.



P on M T or M on T	90°00′
M on *d* 1	154.52
M on *d* 3	119.13 H
M on *a* 1	137.00
M on *a* 2	128.50
M on *b*	141.50 H
T on *c* 1	119.29..
T on *c* 2	139.20
P on *b*	128.20 H
b on *a* 1	160. 2
a 1 on *a* 2	16.355
d 1 on *d* 2	162.17 H

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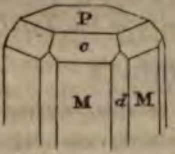
ite—signifying a valuable stone, or gem.

2. STEINHEILITE.*

This mineral also seems to be identical with dichroite. Its colour is either light or Berlin blue; sometimes, though rarely, it is nearly colourless. Analysis by Von Bonsdorff, silex 49.95, alumine 32.28, magnesia 10.45, peroxide of iron, 5.00, oxide of manganese 0.03, volatile matter 1.65.



P on M or M	90°00′
M on M............	120 00
M or M on *d*	150 00
M on *c*............	137 46

It is found in the copper mine of Orrijarvi in Finland.

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Lazulit W. H. Azurite J.

XIV
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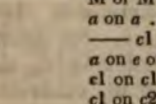
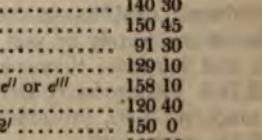
Primary.





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M on M′.....................	121°30′
—— *e* or M′ on *e*′.............	138 45
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M or M′ on *f*	150 45
a on *a*	91 30
—— cl or cl′	129 10
a on *e* or *e*′ or *a*′ on *e*″ or *e*‴	158 10
cl on cl′	120 40
cl on *c*2′ or cl′ on *c*2′	150 0
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It occurs in Vorau in Stiria, in a gangue of quartz, in a vein traversing mica slate; and in Salzburg, in clay-slate.

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[*] So named after Count Steinheil.

[†] Lazulite from Azut, the name by which the Arabs designate this mineral.

HYDRATE OF MAGNESIA.

Native Magnesia, Bruce. Hydrate of Magnesia A.

It occurs in plates, which have a laminated structure, and are frequently disposed in a radiated position. It is described by Dr. Brewster as occurring in regular hexaedral prisms It is white, occasionally with a tinge of green. It is semi-transparent with a somewhat pearly lustre, but becomes opake by exposure; is somewhat elastic, adheres slightly to the tongue, and is so soft as to yield to the nail: its specific gravity is 2.33—2.63: analysis of the American by Dr. Bruce, magnesia 70, and of water 30 per cent; of that of Unst by Dr. Fyffe, magnesia 69.75, water 30.25. It dissolves entirely in the muriatic, nitric, and dilute sulphuric acids.

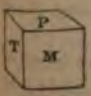
This mineral has been found at Hoboken in New Jersey, in veins from a few lines to a few inches thick, traversing serpentine in every direction: it has lately been found by Dr. Hibbert at Swinaness in Unst, one of the Shetland Isles, traversing serpentine in all directions, mixed with magnesian carbonate of lime, and forming veins from half an inch to six or eight inches thick.

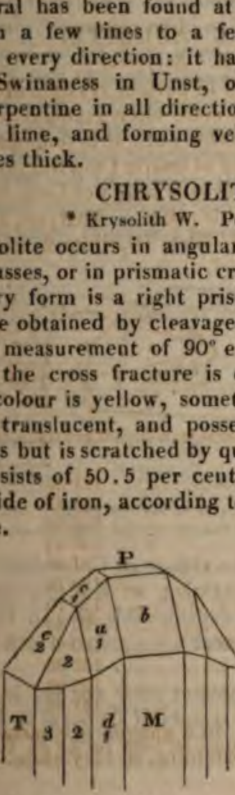
CHRYSOLITE.*

* Krysolith W. Peridot H.

The Chrysolite occurs in angular, or in somewhat rounded crystalline masses, or in prismatic crystals variously terminated. Their primary form is a right prism with rectangular bases, which may be obtained by cleavages parallel to all its planes, yielding the measurement of 90° every way by the reflective goniometer; the cross fracture is conchoidal with a vitreous lustre. Its colour is yellow, sometimes tinged with green or brown; it is translucent, and possesses double refraction. It scratches glass but is scratched by quartz: its specific gravity is 3.4. It consists of 50.5 per cent. of magnesia, 38 of silex, and 9.5 of oxide of iron, according to the analysis of Vauquelin. It is infusible.

Primary.





P on M T or M on T	90°00′
M on *d* 1	154.52
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M on *a* 2	128.50
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T on c 1	119.29..
T on c 2	139.20
P on *b*	128.20 H
b on *a* 1	160. 2
a 1 on *a* 2	16.355
d 1 on *d* 2	162.17 H

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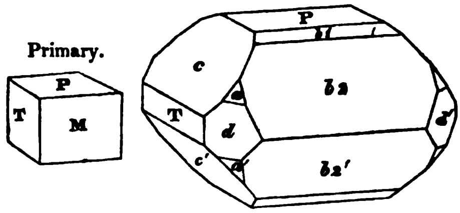
* Chrysolite—signifying a valuable stone, or gem.

It is found near Schelkowitz in Bohemia, and at Jurnau, in the circle of Bunzlau; in serpentine, at Leatschau in Hungary; in the river St. Denis, at the foot of the volcano of the isle of Bourbon; and in the debris of the volcano of Bolsano. The chrysolite of commerce is brought from the Levant.

OLIVINE.

Olivin W. Peridot granuliforme H.

Olivine is considered to be a variety of the chrysolite, though it differs in respect of analysis, the general form of its crystals, and also in cleavage; the proportions of silex and magnesia contained in it are nearly reversed, and it contains a trace of lime. The olivine is chiefly found in olive coloured[*] semi-transparent masses, which, sometimes, from their being in a state of decomposition, have externally an irridescent and somewhat metallic (113) lustre; the fracture is imperfectly conchoidal: it is not so hard as chrysolite. It occurs in crystals whose primary form may be considered a right rectangular prism, but they yield to cleavage with regularity only parallel to the terminal plane P of the following figure. Before the blow-pipe alone it becomes somewhat brown without fusing; without borax it fuses slowly into a diaphanous glass.



P on T or d..	90°00
—— e......	140·00
—— b 1....	132·52
—— b 2....	115.00
T on d.....	130·00
e on e'.....	80·00
b 2 on b 2'...	130·00
d on d'.....	100·00
—— a......	160·00

The above fig. represents a crystal in Mr. Majendie's collection, from the current of lava which flowed into the sea at Torre del Greco.

It occurs in basalt near the village of Colombier in the Vivarais; in the basalt of Bohemia; of Kalberg in Russia; of Hungary; and in masses of considerable size in that of Unkel on the banks of the Rhine, near Cologne; in lava in the isle of Bourbon.

In Britain, it is found together with augite, in the basalt of Teesdale in Durham; in the county of Donegal in Ireland; near Arthur's Seat, Edinburgh, and in trap rocks of Rum and Sky.

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[*] Whence Olivine.

Meteoric Olivine. The semi-transparent yellowish substance enclosed in the mass of meteoric iron found in Siberia by Professor Pallas, is generally considered to be a variety of olivine. It possesses a conchoidal fracture; and consists, according to Klaproth, of 41 per cent. of silex, 38·5 of magnesia, and 18·5 of iron.

CONDRODITE,* BRUCITE, MACLUREITE.

Condrodite Berzelius. Brucite Gibbs. Maclureite, Seybert.

This mineral occurs massive, and in small grains, having occasional, but not very decided appearances of regular external form, and crossed by nearly parallel refts, of which the surfaces have a somewhat pearly lustre. No decided marks of regular internal structure are discernible in them, but the massive of Pargas is divisible into apparently rhombic prisms, and that of New Jersy is described by Cleaveland as occurring in rhombic prisms of 124° and 56°, with dihedral terminations. The colour is wine or wax yellow; it is translucent, scratches glass with ease, and yields to the knife with difficulty. Specific gravity 3·5—3·22. By rubbing it acquires a resinous electricity.

Analysis of that of Pargas, by Count D'Ohsson; magnesia 54·0, silex 38·0, oxide of iron 5·1, alumine 1·5, potash 0·86, manganese a trace. Analysis of that of North America, by Seybert; magnesia 54·000, silex 32.666, fluoric acid 4·086, potash 2·108, peroxide of iron 2·333, water 1·000.

Before the blow-pipe it is infusible on charcoal, but sometimes becomes milk-white; with borax it fuses slowly, but completely, into a transparent glass, slightly tinged by iron.

It was first discovered at Sparta, in New Jersey, in small masses, accompanying graphite in granular carbonate of lime. It is also found massive, and in grains, with the same substance and accompanying the pargasite at Pargas, in Finland; and in the same substance at Aker, in Sudermania.

SERPENTINE.

It is properly divided into two kinds, Noble Serpentine and Common Serpentine.

1. NOBLE SERPENTINE.

Edler Serpentin W. Serpentine Noble Br. Precious Serpentine J.

It occurs massive, of various shades of green and yellowish green; its colour is uniform: its fracture is splintery passing into conchoidal; it is translucent, possesses a glimmering or glistening resinous lustre; is occasionally somewhat unctuous to the touch, and yields easily to the knife. Its specific gravity is 2.2. According to the analysis of Hisinger, it consists of 37·24 magnesia, 32 of silex, 0.5 of alumine, 10.2 of lime, 14 of water, and 6 of oxide of iron. Analysis by John; silex 42.50, magnesia 38.63, alumine 1, lime 0.25, oxide of iron 1·50, oxide of manganese 0.62, oxide of chrome 0.25, water 15.20, loss 0.05.

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* Condrodite, from its occurring in grains. Brucite, in honor of the late Professor Bruce of New York. Maclureite, in honor of Mr. Maclure.

Before the blow-pipe the thin edges may be fused into an enamel; with borax it fuses slowly into a greenish transparent glass.

It is commonly found in beds and masses in primitive limestone, gneiss, and mica-slate, whence it has been termed *Primitive Serpentine.*

In Italy it is intermixed with limestone forming the Verd Antique marble. It also occurs in Silesia, Sweden, Bohemia, and the Tyrol. In primitive limestone in Connecticut, North America, with magnetic oxide, and chromate of iron. At Newbury Port, Massachusetts, in granular limestone with which it is often intermingled.

In Scotland, it occurs in the marble of Glen Tilt. It occurs in Holyhead Island.

A variety of the serpentine of Cornwall, found in veins and small masses, belongs to noble serpentine.

2. COMMON SERPENTINE.

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(114)

The characters of this variety differ greatly from those of the preceding. It is of various shades of green, brown, and red; the brown mostly prevailing, and the colours are variously intermixed: it is opake, but sometimes translucent on the edges; the fracture is uneven, but occasionally approaches the flat conchoidal; sometimes it scarcely yields to the knife, sometimes it gives out an argillaceous odour when breathed on. Specific gravity 2.5. It is said that some varieties not only move the magnetic needle, but possess magnetic poles. Analysis by Vauquelin; magnesia 44, silex 44, alumine 2, oxide of iron 7.3, oxide of manganese 1.5, oxide of chrome 2.

In Scotland, it occurs at Portsoy in Banffshire; at the bridge of Corlachie in Forfarshire; in Ayrshire; in the Shetland isles, Unst and Fetlar; in Glass one of the Hebrides. In Cornwall, the large serpentine tract of that country is associated with greenstone and slates.

E. C11
38

ZIRCON.

Zirkon W. Zircon H.

The three minerals which are principally composed of Zircon, viz. the hyacinth, the jargoon, and the zirconite, all occur crystallized. The form of their primary crystal is an obtuse octohedron, with a square base, which occurs only among the opaque brown crystals forming a variety of the jargoon. Its angles taken by the reflective goniometer, on natural planes, are 84° 20′ and 95° 40′. The crystals of these substances, of which I possess about 45 varieties, resemble, in a remarkable degree, those of the oxide of tin, which also have for their primary crystal a flat octohedron: they are doubly refractive when translucent, are harder than quartz, and their specific gravity exceeds 4. These substances are infusible, but sometimes lose their colour by exposure to heat.

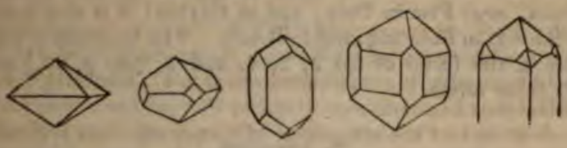
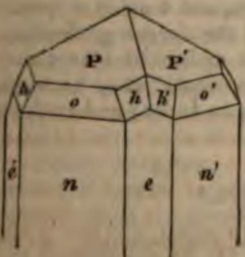


Fig. 1. The primary octohedron. Fig. 2, the same having its lateral solid angles replaced. Fig. 3, is the same as Fig. 2: but the replacement of its angles gives to the crystal the form of a quadrangular prism terminated by four-sided pyramids with rhombic planes. Fig. 4. In this, the edges formed by the meeting of two pyramids of the primary octohedron, are also replaced Fig. 5, shews the solid angles formed by the meeting of the prism and pyramid, replaced each by two planes.



P on P, or P′ on P′ over the summit	95°40′
P on P′	123 15
P on *n* or P′ on *n*′..	132.10
P or P′ on *e*.......	118.12
P on *o*	153.15
P on *h* or P′ on *h*′ .	150.12
h on *h*............	147.12
h or *h*′ on *e*	147.50
h on *h*............	133. 0
e on *e*′............	90.00
n on *n*′	90.00
n or *n*′ on *e*	135.00
h on *n* or *h*′ on *n*′ ..	148.17
n on *o*............	159.35

1. HYACINTH.*

The Hyacinth is of various shades of red, passing into orange red; it is transparent or translucent: its structure is lamellar, yielding to cleavage parallel with the faces of the primary octohedron, and with a plane passing through the summits and the centres of the planes of its pyramids. Its cross fracture is conchoidal, with a vitreous lustre: it is semi-transparent. The Hyacinth of Ceylon consists of 70 per cent. of zircon, 25 of silex, and 0.5 of oxide of iron: Klaproth. Dr. Thomson found alumine a constant ingredient. That of Expailly consists of the same constituents, nearly in the same proportions. Before the blow-pipe, alone, it is infusible, but with borax, melts into a diaphanous glass.

The hyacinth is commonly found in the beds of rivers or of brooks. It occurs in the brook Expailly, in Auvergne in France, in a sand that is considered to be of volcanic origin; and is also met with in a sand of the same description in the territory of Vicenza, near Pisa in Italy, and in Ceylon: it is also found at Schelkowitz in Bohemia, and in Brazil. The hyacinth of France occurs in the forms of figs 2, 3, 4, and 5, (see p. 99,) and in many other forms.

2. JARGOON.

The Jargoon occurs in small transparent or translucent crystals, which are considerably prismatic (fig. 3), and of a greyish, yellowish, brownish, or reddish colour, having frequently a smoky tinge; and in rounded masses, as well as in crystals of considerable dimension, very nearly approaching their primary form, (fig. 1) and of a brown colour and opaque: they seem to possess no regular structure. Jargoon consists, according to Vauquelin, of 66 per cent. of zircon, 31 of silex, and 2 oxide of iron.

This substance is usually called the *Jargon of Ceylon*: it is found in the sands of rivers in the middle of that island with spinelle ruby, sapphire, and iron-sand; also, according to Bournon, in the district of Ellore, in India; and in the brook Expailly, in France.

3. ZIRCONITE.†

The Zirconite is of a reddish brown colour, and nearly opaque: it occurs in prismatic crystals (fig. 5); by the analysis of John it consists of 64 of zircon, 34 of silex, 0.25 of oxide of iron, and 1 of titanium.

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* From its resemblance in colour to that of the flower called hyacinth by the ancients.

† Zirconite, from its containing the earth Zircon.

It occurs imbedded in sienite at Frederick-Schwerin in Norway; at Kitiksut in Greenland; in Carinthia; in North America, it is found in granite near Baltimore, and in New York; in gneiss in New Jersey.

In Scotland, in sienite in Galloway in minute crystals; in Sutherland in well defined crystals of considerable size.

All the varieties of Zircon are cut and polished by the lapidary, but in general are not greatly esteemed; the hyacinth is often of a beautiful brilliant colour when set as a gem, but it wants dimension. The exposure of some varieties to heat, deprives them of their colour, and they are said to have been sold in that state in place of the diamond.

EUCLASE.

Euclase H.

It occurs in crystals which, when held in one direction, may be termed prismatic; the prism sometimes appearing rectangular, CXXVIII
sometimes rhombic, and variously modified and terminated. 39
The principal cleavage is parallel to the plane P[*] of the following figures; it cleaves also parallel to M and T; which, together with the measurements, and the nature of the modifying planes, prove the primary form to be a right oblique-angled prism. The planes P and T, and the intermediate planes, (which at first sight appear only as striæ) are those of the apparent prisms of the crystals, which usually are attached to the matrix at M, or the opposite plane. It is either colourless and nearly transparent, or light green of various shades, or bluish green and blue; the cross fracture is conchoidal, with a splendent vitreous lustre. Specific gravity 3.06.

Analysis by Berzelius; glucine 21.78, silex 43.32, alumine 30.56, oxide of iron 2.22, oxide of tin 0.70. Before the blowpipe it first becomes opake, and then melts on the edges into a white enamel; with borax it ultimately and slowly melts into a transparent colourless glass.

The annexed figures represent the planes of some crystals in the possession of my friend H. J. Brooke, from which also I obtained the accompanying measurements by the assistance of reflective goniometer.

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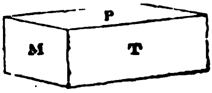
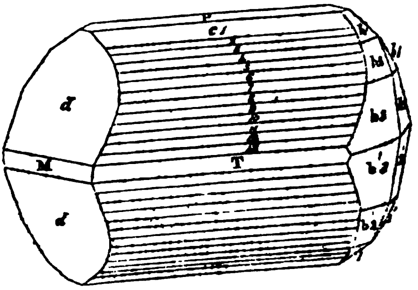
[*] Euclase, from the Greek, signifying easily broken; in allusion to the ease with which it cleaves in that direction.

Primary,





P on M or T	90° 00′	P on *c* 12	103.28
M on T	130.52	—— *c* 13	100.50
T on *b* 1	98.50	—— *b* 1	123.10
—— *b* 2	100.10	—— *b* 2	108.24
P on c 1	124.30	—— b 1	130.10
P on *d*	124.24	—— b 2	112.50
—— c 1	122.28	—— b 3	139.18
—— c 2	121.30	*b* 1 on *b* 2	165.18
—— c 3	120.10	*b* 2 on *b* 2′	143.32
—— c 4	116.05	b 1 on b 2	162.20
—— c 5	112.50	b 2 on b 3	169.48
—— c 6	111.50	b 2 on *b* 1	143.20
—— c 7	109.40	*d* on d	105.20
—— c 8	108.46	c 1 on *d*	140.00
—— c 9	107.20	—— b 1	148.10
—— c 10	106.22	—— *b* 1	115.20
—— c 11	105.14		

It was first found in Peru in very small quantity; and has since been brought from the Brazils in isolated crystals, but neither the circumstance under which it occurs, nor its precise locality, is known.

BERYL.* AQUAMARINE.

Edler Beryl W. Emeraude verte-bleuâtre & jaune-verdâtre H.
Beril aigue-marine Bt.

The Beryl is of various shades of pale yellow, green, and blue; its common form is that of the hexahedral prism, which sometimes is deeply striated longitudinally, and terminated by a six-sided pyramid, of which the summit is replaced; or the terminal edges and angles of the prisms are replaced by

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115)

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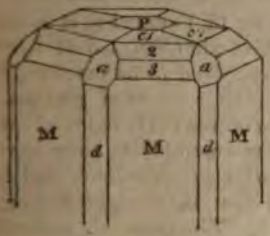
* Called Beryllos by the Greeks. Aquamarine from the latin; sea-water —in relation to its colour.

small planes. It occurs in crystals of various sizes; they have been met with a foot or more in length, and four inches in diameter, and nearly transparent. It is harder than the emerald, and more readily yields to cleavage, parallel to all the planes of its primary form, the hexahedral prism, but occurs in nearly the same crystalline forms. Its specific gravity is 2.67. According to Vauquelin, the beryl consists of 14 per cent. of glucine, 68 of silex, 15 of alumine, 2 of lime, and 1 of oxide of iron. It is changed to a light blue by a moderate heat; by increasing the heat it becomes like mother of pearl; the emerald has the same kind of pearly lustre when heated; with borax it fuses into a transparent colourless glass.



P on MM or M ...	90° 00
M on M	120.00
P on *a*	135.14
—— c 2..........	150.10
c 1 on c' 1	179.40
M on *d*	150.00

It belongs to primitive countries; it occurs in veins traversing granite, chiefly of the variety termed graphic: its gangue is quartz, or compact ferruginous clay.

It is found in the greatest abundance and purity near Nertchink in Daouria, on the confines of China, in compact ferruginous clay. It occurs in the Altaic chain in Siberia; and in Persia in a vein traversing a granite mountain, and is accompanied by quartz, topaz, and crystallized felspar. It has also been found in greenish white and opaque crystals, in a vein passing through granite near Limoges in France; and near Autun, in a rock chiefly consisting of felspar; in graphic granite in Pennsylvania. The beryl is also found in Peru, Brazil, Saxony, the isle of Elba: and also in several of the United States of America in granite.

It occurs in Kinloch Raimoch and Cairngoram in Aberdeenshire, Scotland. In the mountains above Dundrum in the county of Dublin; and in granite near Lough Bray, and near Cronebane in the county of Wicklow in Ireland.

It is usually considered a variety of the emerald, but differs from it both in hardness and composition, and mostly in colour.

EMERALD.

Schmaragd W. Emeraude verte H.

E. C
40

The form in which the Emerald usually occurs, is that of a six-sided prism, which also is that of its primary crystal; it is occasionally modified at the terminations, which greatly resemble those of the beryl. Its colour is a pure and beautiful green* of various intensity; it is somewhat harder than quartz, but not so hard as the beryl, and though it exhibits joints parallel with the planes of the prism, it yields to cleavage with more difficulty than the beryl; its cross fracture is conchoidal with a vitreous lustre: it never occurs in very large crystals, which are transparent or translucent; those of Broddbo are translucent or opaque. According to Vauquelin, it consists of 13 of glucine, 64.5 of silex, 16 of alumine, 1.6 of lime, and 3.25 of oxide of chrome; it is supposed to be coloured by the latter substance. That of Broddbo consists of glucine 13.13, silex 68.35, alumine 17.60, oxide of iron 0.27, oxide of tantalum 0. 72: Berzelius; but since these emeralds as they have been termed, are of a bluish or yellowish green colour, and contain no chrome, it may be inferred that they ought rather to be considered varieties of the beryl. The emerald, according to Berzelius, suffers no change alone under the blow-pipe with a gentle heat; with borax fuses into a transparent colourless glass.

The emeralds known to the ancients were found in Upper Egypt, and the mountains of Ethiopia. The finest are found in Peru. The mine of Manta is exhausted; the present mine is situated in the valley of Tunca, in Santa-Fé, between the mountains of New Grenada and Popayan: emeralds occur there in veins, or in cavities, in granite. A variety of it has lately been found at Broddbo in Sweden. They have also been found in some secondary countries; in which they are supposed not to have been in their original situation.

The emerald is reckoned among the gems; and when of a fine colour and without flaws, is highly esteemed. The large emeralds spoken of by various writers, such as that in the Abbey of Richenau, of the weight of 28 pounds, and which formerly belonged to Charlemagne, are believed to be either green fluor, or prase. The most magnificent specimen of genuine emeralds was presented to the church of Loretto by one of the Spanish kings; it consists of a mass of white quartz, thickly implanted with emeralds more than an inch in diameter.

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* Whence Emerald, from the Greek.

GADOLINITE.*

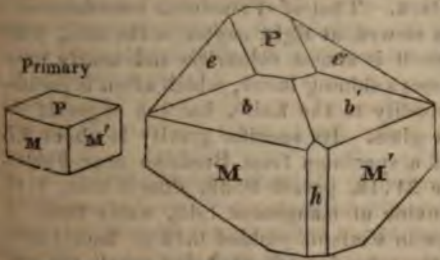
Of this mineral there appear to be two varieties, which however do not seem as yet to be thoroughly understood: &. X

1. VITREOUS.

It is of a greenish or brownish black colour, and occurs massive. It is opake, or slightly translucent on the edges, and hard enough to scratch glass: its fracture is flat-conchoidal, with a splendent or resinous lustre: it appears to consist by the analysis of Berzelius, of yttria 45.93, protoxide of cerium 16.90, silex 24.16, protoxide of iron 11.34, water 0.60. Before the blow-pipe, alone, it intumesces, throws out cauliflower-like ramifications, and becomes white, giving off moisture. This occurs at Ytterby, Broddbo and Finbo.

2. CRYSTALLISED.

This occurs both massive and crystallised, and is described by Berzelius as possessing "a yellow granular fracture;" but the crystal represented by the following figure is nearly iron black, and dull externally, internally black and shining; its primary form appears to be an oblique rhombic prism. It is considered by Berzelius to consist of gadolinite with small quantities of silex, lime, and the protoxides of manganese, cerium and iron, and glucine. One specimen (as it may be assumed) of this variety yielded by the analysis of Klaproth, 54.75 of yttria with a trace of manganese, 21.25 of silex, 5.5 of glucine, 0.5 of alumine, 17.5 of oxide of iron, and 0.5 of water.



M on M′ .	115° 0 *c.g.*
P on *h* ...	98 0
M on *e*, or M′ on *e*′..	100 0
M on *b*, or M′ on *b*′..	153 0
b on *b*′ ...	120 0
e on *e*′ ...	120 0
b on *e*, or *b*′ on *e*′ ...	130 0

The above figure represents a crystal in the possession of Mr. Brooke.

This variety is from Korarf.

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* After Gadolin, its discoverer.

ALKALINO-EARTHY MINERALS.

The Minerals included under this term generally consist, primarily, of Earths in various proportion; they include also some proportion of one or more of the Alkalies, giving them a very important chemical distinction. Most of them contain some iron, and some of them manganese; which in most, if not in all cases, may properly be considered as accessory, rather than essential ingredients.

MICA.*

Glimmer W. Mica H.

XXX Mica occurs disseminated in rocks, massive, and in six-sided
(116) crystals, mostly tabular; it also occurs in the form of an oblique
rhombic prism of 60° and 120°, which is the form of its primary
XXXI crystal. It is easily divisible parallel with the terminal planes
into thin laminæ, which are flexible and very elastic; this last
(117) character serves at once to distinguish mica from talc, which is
not elastic. It is of various shades of white, yellow, green, and
CXCIV brown, sometimes black. That of Vesuvius is sometimes of a
rich red brown when viewed at right angles to the axis, while
(118) in the other direction it is almost colourless and nearly transparent.
Mica possesses a shining lustre, which often is pseudometallic;
CXCV it yields readily to the knife, but the edges of the
(119) crystals will scratch glass. Its specific gravity is about 2.7.
Analysis by Rose of a specimen from Broddbo near Fahlun,
CXCI silex 46.10, alumine 31.16, potash 8.39, *fluoric acid*, 1.12.
oxide of iron 8.65, oxide of manganese 1.40, water 0.87. A
(120) specimen from Kimito in Finland yielded 0.76 of fluoric acid;
one from Uto 0.56; the other ingredients being nearly the same
as that of Broddbo: all the varieties he could procure contained
fluoric acid. Under the blow-pipe, mica from different countries

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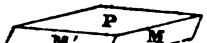
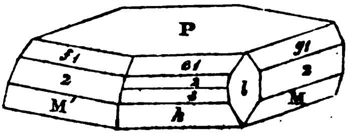
* Mica in allusion to its property of shining.

was found by Berzelius to give different results. Two melted into different coloured glass—one into enamel; one only gave a trace of fluoric acid.

Primary form.





M′ on M	60°00′	P on *e*2	94°30′
P on M′	98.40	———*e*3	92.55
——— M	81.20	———*k*	90.00
———*f*1	135.16	———*l*	100.20
———*f*2	121.45	———*g*1	107. 5
———*e*1	114.30	———*g*2	83. 2′

It is an essential ingredient of very many rocks, especially those termed the oldest primitive, as granite, gneiss, mica-slate, DXXXI &c. and is often found filling up their fissures, or crystallized (121) in the cavities of the veins which traverse them. Mica is therefore of the most ancient formation; but is also met with in the newest crystalline rocks. It also occurs in sandstones, in schists, and in the slaty sandstone that accompanies the independent coal formation. It is sometimes abundant in sands, and in alluvial deposits very distant from primitive mountains; and is found finely crystallized in the ejected masses of Vesuvius.

According to Haüy, Muscovy Glass, which occurs in plates of a yard or more in diameter, in veins of granite and micaceous schistus, in some parts of Russia, may be divided into plates no thicker than $\frac{1}{100000}$th part of an inch. It is used for enclosing objects for the solar microscope, and instead of glass in the Russian ships of war, as less liable to be broken by the concussion of the air, during the discharge of heavy artillery; an inferior kind, which is found in Pennsylvania, is used there instead of window glass.

LEUCITE.*

Leuzit W. Amphigène H. Vesuvian, Kirwan.

The Leucite occurs in little masses having more or less the G. XXVI appearance of crystals rounded by attrition; also in crystals, 4 whose planes are 24 equal and similar trapeziums, apparently with joints parallel to the rhombic dodecahedron and the cube; the latter of which, being the most simple of the two, has been adopted as the form of the primary crystal. The Leucite is generally of a dirty white or grey colour, seldom reddish white, and is occasionally somewhat translucent; it scratches glass with difficulty; its cross fracture is imperfectly conchoidal, mostly with a vitreous lustre. Its specific gravity is 2.37. It consists of 53.75 of silex, 24.62 of alumine, and 21.35 of potash. Under the blow-pipe it is infusible, even in powder; with borax, fuses slowly into a diaphanous glass.

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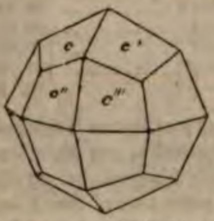
* Leucite signifies a white substance: Amphigène, of a double origin, in allusion to its being found in the earlier rocks and in volcanic matter.



c on c' .... 131°48′ 16″ H

c on c'' or c' on c''' } ..... 146.26.33 ..

The manner in which this crystal is derived from the cube will be apparent on consulting the crystalline forms of Analcime.

The Leucite is said to have been found in some of those which are esteemed to be early rocks, but the accounts are doubted; it is most commonly found among the productions of volcanoes; that which occurs in lava is mostly opaque, while that found in basalt is vitreous. The lavas of Vesuvius, and basalts of Italy and Bohemia abound with this mineral. The road from Rome to Frascati is in many places quite covered with it.

ANDALUSITE.*

Andalusit W. Feldspath apyre H.

It occurs massive, and in slightly rhombic prisms; it has a lamellar structure, with joints parallel to the sides of a rhombic prism, measuring by the reflective goniometer 88° 40′ & 91° 20′ on the cleavage planes. It is of a reddish colour, sometimes a purplish red, and is translucent or opaque: it scratches glass, and sometimes even the spinelle ruby. Its specific gravity is 3.16. It is composed of 52 of alumine, 38 of silex, 8 of potash, and 2 of oxide of iron: Vauquelin. It is infusible before the blow-pipe, alone; with borax fuses with difficulty into a transparent colourless glass. That from the Tyrol scratches glass, is very easily frangible, is not altered by heat before the blow-pipe, with calcined borax melts readily, and when cold assumes the form of a greenish bead.

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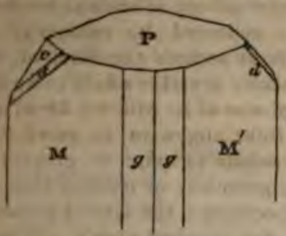
* Andalusite, from Andalusia in Spain, where it was first found.



M on M	91°20′
P on M or M′ .	90.00
P on *c*	140.00
c on *d*	145.00
g on *g*	125.00

The Andalusite belongs to primitive countries. It was first found in Andalusia in Spain. It occurs in a vein of felspar traversing granite in Forez in France, and it has been found in ash grey dolomite also containing tremolite, in the Simplon, and in black carbonate of lime containing granular pyrites, at Coulepeux in the valley of Ger, department of the Haut Garonne: at Readfield in the United States: in granite in Castelle in Spain: in mica-slaté in Aberdeenshire in Scotland; and in the isle of Unst: in Dartmoor in Devonshire: it has also been found in mica-slate in Douce mountain in the county of Wicklow, and is also very plentiful in mica-slate at Killiney in the county of Dublin, in Ireland.

DVIL(12

BUCHOLZITE.*

Dr. Brandes.

This mineral is described as being amorphous, spotted with white and black, as having a glistening lustre, which is waxy, pearly, and glassy; as separating into fibres, especially in the black part, but in the white and grey, the texture is often perceived with difficulty. The cross fracture is occasionally conchoidal. A tendency to a lamellar structure is said to have been observed, the cleavage indicating some analogy with that of felspar. The fragments are mostly wedge-shaped and sharp. In thin fragments it is slightly translucent. It scratches glass, but is scratched by quartz. Analysis by Dr. Brandes, silex 46, alumine 50, potash 1.5, oxide of iron 2.5.

It is from the Tyrol, and was first noticed by its analyst Dr. Brandes.

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* So named in honour of Bucholz the Chemist.

APOPHYLLITE.*

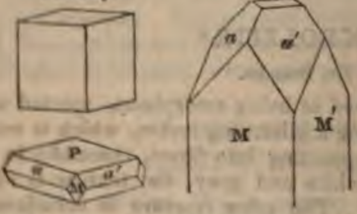
Fishaugenstein W. Apophyllite H. Ichthyophthalmite.

XXVI 43

XX (123)

Apophyllite occurs in square prisms of various heights: the solid angles are sometimes replaced by triangular planes, which by a deeper replacement assume the form of rhombic planes; the structure is lamellar; it yields easily to mechanical cleavage, parallel to all the planes of its primary form, a square prism, but most readily at right angles to its axis; the cross fracture is uneven. The colour is pure or greyish white, sometimes with a yellowish, greenish, or reddish tinge. It is transparent, translucent, or opaque; the lateral planes of the prism have a shining lustre; the terminal pearly. It scratches fluor with some difficulty. Its specific gravity is 2.46. It becomes feebly electric by rubbing. According to Vauquelin, it consists of 51 silex, 28 lime, 4 potash, and 17 water. Analysis of that of Greenland by Stromeyer, silex 51.85, lime 25.22, potash 5.30, water 16.90; that of Uto, analysed by Berzelius, differs only from the preceding, in containing a small portion of fluoric acid, considered to be in combination with the lime, which in the estimation of Berzelius, is in the state of a fluo-silicate. It exfoliates before the blow-pipe, and ultimately fuses into a white blebby glass; in nitric acid it separates into flakes and becomes gelatinous and semi-transparent.

Primary.



P on M or M' ..	90°00'
M on M'	90.00
P on a or a' ...	120. 5
M on a or M' on a'	128.23
a on a'	104.18

It is met with in the iron mine of Utoe in Sweden; its gangue is a lamellar carbonate of lime, of a red violet colour; it is accompanied by hornblende and some ores of iron; also in the copper mine of Fahlun: at Arendahl in Norway: in East Gothland: in Faroe, and at Discoe in Greenland; at Tafta in the Tyrol, of a reddish hue, and with tabular spar at Rydbania in the Bannat.

Dr. Mac Culloch found a solitary crystal at Dunvegan in the Isl-

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[illegible] its exfoliating before the blow-pipe.

1. ALBIN.[*]

This mineral has lately been discovered at Mariaberg near Aussig in Bohemia, filling up or lining the cavities of lava, in which case it forms tubercular masses. The massive consists of an aggregation of crystalline laminæ, which possess a laminated structure, but which are variously placed in regard to each other.

SCALY TALC. NACRITE.

Erdiger Talc W. Talc granuleux H. Nacrite Bt. J.

This mineral occurs in minute aggregated scales, of a silvery white or greenish colour, and of a glimmering pearly lustre; the mass is friable, very unctuous to the touch, light, adheres to the fingers, and gives out the argillaceous odour when breathed on. Scaly talc is composed of 50 per cent. of silex, 26 of alumine, 1.5 of lime, 17.5 of potash, 5 of oxide of iron, and a small portion of muriatic acid: Vauquelin. Its colour distinguishes it sufficiently from chlorite; it differs from the lepidolite principally in respect of colour, and in being extremely unctuous. By its analysis it appears to be allied more closely to mica than talc.

It is chiefly met with in small masses in the cavities of primitive rocks, and in the interstices of crystallized quartz. It occurs at Piedmont, near Freyberg in Saxony, and near Meronitz in Bohemia.

HAÜYNE.[†]

Haüyn Karsten. Latialite H.

The Haüyne is usually found in grains and massive, but it has been observed in extremely brilliant crystals, in the form of the rhombic dodecahedron. When this mineral is opaque, it is of an indigo blue colour; when translucent, blue, or bluish green. It is somewhat harder than quartz, is very brittle, and its fracture is conchoidal, and considerably splendent. Its specific gravity is about 3.2; and it consists of 30 per cent. of silex, 15 of alumine, 20.5 of sulphate of lime, 5 of lime, 11 of potash, 1 of oxide of iron, 17.5 water, sulphuretted hydrogen, &c. Before the blow-pipe on charcoal it loses its colour, and fuses into a blebby glass; with borax into a diaphanous glass, which becomes yellow on cooling.

E. CVII

44

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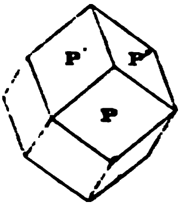
[*] From its opaque white.

[†] Haüyne, in honor of the late justly celebrated French mineralogist, Haüy.



P on P' or P on P'' } 120° 0'
or P' on P'' .... }

It occurs massive in Italy, in the neighbourhood of Nemi, Albano, and Frascati, accompanied by mica, and green pyroxène; and near Vesuvius its gangue consists of the fragments of rocks ejected by volcanic eruptions, and it is accompanied by idocrase, augite, mica, and meionite. It is also found in the basalt of Andernach.

It was lately discovered in the limestone of Tiree, one of the Scottish islands, in grains not exceeding a line in diameter, in nodules composed of felspar, mica, and sahlite.

PEARLSTONE.

Perlstein W. Lave vitreuse perlée W.

Pearlstone occurs in large course angular concretions, composed of smaller round concretions, which consist of very thin lamellæ. The surface is smooth and shining, with a lustre remarkably resembling that of pearl.* The colour of the mass is grey, greyish black, brown, reddish or bluish. It is fragile, translucent on the edges, and scarcely hard enough to scratch glass. Its specific gravity is 2.34; that of Hungary is composed of silex 75.25, alumine 12, lime 4.5, potash 4.50, oxide of iron 1.6, and water 4.5. It almost always gives out an argillaceous odour when breathed on. Some of the varieties are said to bear a striking resemblance to pumice. It melts into a whitish frothy glass.

At Tokay in Hungary, it is found enclosing round masses of black vitreous obsidian, and is intermixed with the debris of granite, gneiss, and porphyry, and alternating in beds with the latter. A variety met with at Cinapecuaro in Mexico, is hard enough to scratch glass. It is found at Cap de Gate in Spain, of a greenish or bluish colour; also in Iceland.

Pearlstone is met with at Sandy Brae, Antrim, in Ireland.

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* Whence Pearlstone.

GIESECKITE.*

Giseckite, Stromeyer.

is mineral occurs in regular six-sided prisms, by admeasure- with the common goniometer; externally, the prisms are rownish tinge, internally greenish and blackish green in- ted; it possesses no regular structure; but on the con- being granular, with a waxy lustre, it has rather the ap- ice of a pseudomorphous steatitic mineral, than of a crys- substance: the crystal is opaque, but small fragments are icent; it yields to the knife, affording a white powder, ratches common glass, on which the white powder of the il is left. Specific gravity 2.7—2.9. Analysis by Stromeyer 16.27, alumine 33.82, magnesia 1.2, potash 6.2, oxide 3.35, water 4.8.

E. CI.
45

was brought by Sir C. Giesecké from Akulliarasiarsuk in ıland.

FELSPAR.†

Feldspath W. H.

Felspar there are several varieties; all of which agree in il characters. They are constituted of the same ingre- , which vary a little in respect of relative quantity. Most em occur both massive and crystallized; the structure is s lamellar, and they yield with more or less ease to me- cal cleavage. All the varieties scratch glass, and yield ew instances with some difficulty to the knife.

Globular
E. CXXXIX
46
Napoleonite

1. ADULARIA. MOON-STONE.‡

Adular W. Feldspath nacré W.

is variety of Felspar is semi-transparent, or translucent; f a greyish or greenish white, or milk white, and is fre- ly irridescent. It occurs both massive and crystallized. very splendent, with a pearly lustre, and exhibiting, ially when cut and polished, a bluish or greenish white yant reflection of light, it is termed *Moon-stone*; the cross re is imperfectly conchoidal. Specific gravity 2.54. By ielin's analysis, it consists of silex 64, alumine 20, lime 2, h 14. It melts into a white transparent glass.

occurs in veins and cavities in granite, gneiss, clay-slate, imestone; with quartz, felspar, amianthus, &c.

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[*] honor of Sir C. Giescké.

[†] rom the German Feldspath, field-spar; in allusion perhaps to its being loose on the surface of some parts of the country.

[‡] dularia, from Mount Adula, on which it is supposed first to have been : Moon-stone, from the brilliant light reflected by it.

It is found in the granite and gneiss of several European countries: St. Gothard yields the finest specimens, sometimes even a foot in thickness. Also in granite in North America: in New York in veins of quartz, traversing limestone.

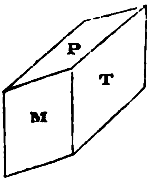
In Britain it occurs in the granite of Arran; in the veins passing through schist at Tintagel on the northern coast of Cornwall, accompanied by chlorite, calcareous spar and rock crystal: with rock crystal on Snowdon, North Wales.

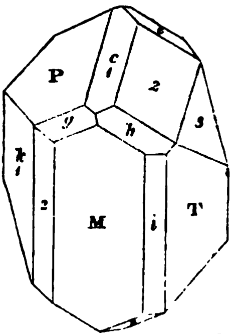
The finest specimens of Moon-stone are from Ceylon.

2. COMMON FELSPAR.

LVII Common Felspar is sometimes translucent, mostly opaque, or
translucent only on the edges; the lustre on the lamellar frag-
(124) ments is between vitreous and pearly; the cross fracture is
CXI uneven and glimmering. It occurs of a whitish, yellowish,
blue, green, reddish or red colour, and either granular, massive,
(125) disseminated or crystallized. The crystals yield to cleavage
parallel to the planes P M & T of the following figures, afford-
CXII ing a doubly oblique prism as the primary form of its crystals,
which presents by the reflective goniometer in one direction, four
(126) angles of 90°; in another, four alternately of 59° 25′ & 120° 35′;
in another, four, alternately of 67° 15′ & 112° 45′: the latter
XIII are obtained with great difficulty, the former with more ease,
and the natural joints are generally visible in a direction parallel
(127) to the plane P. Its specific gravity is 2.54; it is composed of
XIV 62.83 parts of silex, 17.02 of alumine, 3 of lime, 13 of potash,
and 1 of oxide of iron. Vauquelin. On charcoal it is fusible
(128) with borax into a semi-transparent glass.

Primary form.





M on T	120°35′00″
P on M	90.00.00
—— T	67.15.00
—— *c* 1 ...	145.20.00
—— *c* 2 ...	129.30.00
—— *c* 3 ...	99.41. 8 H
—— *k* 1 ...	112. 5.00
M on *c* 1 ...	90.00.00
—— *i*	150.00.00
—— *k* 1 ...	120.30.00
—— *k* 2 ...	150.00.00 H
—— *h*	116.35.00
T on *c* 2 ...	111.00.00
—— *i*	150.00.00 H
—— *k* 1 ...	60.50.00
c 1 on *c* 2 ..	164.42.00
c 2 on *c* 3 ..	150.45.28 H
c 1 on *h* ...	149.10.00
c 2 on *h* ...	152.30.00
k 1 on *k* 2 ..	150.00.00 H

CXXXII Common Felspar is the most generally diffused of any other
(129) mineral, except quartz and oxide of iron. It is an essential

constituent of granite and gneiss, and also frequently occurs in CCCXXXII (130
them in veins, and in micaceous and argillaceous schistus; it CCCCXCII (1
abounds in primitive and secondary traps, and in the greater
part of real lavas.

A variety of a beautiful apple *green* colour (*Amazon-stone*,) DXLI (13
has been met with only in a hill at the eastern base of the DXXXXI (
Uralian mountains, near the fortress of Troitzk.

3. GLASSY FELSPAR.

Glasiger Feldspath W.

It occurs generally in crystals which have the appearance of being cracked in various directions, and are mostly imbedded. It obtained its name of Glassy, from its vitreous lustre: it is semi-transparent and translucent, and of a greyish or yellowish white colour. Its specific gravity is 2.57; and it is composed of 68 parts of silex, 15 of alumine, 14.5 of potash, and 0.5 of oxide of iron. Klaproth. It melts into a semi-transparent glass.

It occurs imbedded in porphyry-slate? in Bohemia, at Drachenfels near Born on the Rhine; at Solfatara in Italy; in pumice in Hungary. In Scotland, in Pitchstone in the Isle of Arran; with augite in the Isle of Rum.

4. LABRADOR FELSPAR. OPALESCENT FELSPAR.

Labradorstein W. Feldspath Opalin H.

The beautiful and varied tints of this mineral, when viewed in particular directions, are well known; it never occurs crystallized, its structure is lamellar, generally somewhat curved; its general colour is grey, or dark ash grey; it has a glimmering lustre, and is translucent on the edges; by some of the analyses of this mineral, which are not greatly relied on, it appears that potash does not enter into its composition. Its specific gravity is 2.5.

It was first discovered by the Moravian missionaries in the island of St. Paul, on the coast of Labrador;* it has since been found in Ingermannland in Norway; in Laurwig in the same country, it is an ingredient of the sienite containing zirconite; near the lake Baikal in Siberia; in granite near St. Petersburg; also at Memelsgrund in Bohemia, and near Halle in Saxony. It is sometimes accompanied by mica, schorl, and iron pyrites.

5. BLUE FELSPAR.

It occurs massive; its colour is pale blue or sky-blue; it has a lamellar structure, being divisible into the same form as Σ.CV

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[*] Whence Labrador Felspar: Opalescent Felspar, from its play of colour.

common felspar; it is not quite so hard as quartz. Its s gravity is 3.06; it is composed of 71 of alumine, 14 of 3 of magnesia, 3 of lime, 0.25 of potash, 0.75 of oxide o and 5 of water.

Hitherto it has only been found at Krieglach in Styria, ing part of a rock, consisting likewise of quartz and mi talc.

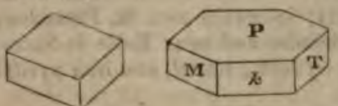
TALC.

Talc W. H.

It occurs in hexagonal tabular crystals, massive and indi The primary, according to Haüy, is a right rhombic pri 120° and 60°. It always consists of plates or laminæ, whi easily separated from each other, and are flexible, b elastic. This last character serves to distinguish this n from mica, which is very elastic. Talc is white, yellow of various shades of green, and is translucent; it is of a lustre, and is very unctuous to the touch, and yields easily nail; it leaves a white, and somewhat pearly streak, when on paper. Its specific gravity 2.77; and it consists of
XXXCII silex, 30. 5 of magnesia, 2.75 of potash, 2.5 of oxide o
(134) and 0.5 of water, according to the analysis of Klaprot that of Vauquelin afforded no potash. Before the blo it whitens, but alone, does not fuse; with borax af transparent glass.

XXXCIII *Crystallized* talc, which is mostly white, or of a light
(135) colour, is met with in small quantities in serpentine with actynolite, carbonated lime, steatite, massive ta It is found in the mountains of Salzburg and the
XXXIV and is taken to Venice; whence it has obtained th
(136) of *Venetian Talc.* It occurs also at Brainçon; at in Saxony; in Silesia, &c. and in Piemont of a dar
LXXXV colour with white garnets.

(137) Primary.



P on M or T	90°00′
M on T.....	60°00′
M on *k* ... or T on *k* ...	120°00′

The above figures and measurements are given on the authority

CCXC *Massive* talc is less flexible and translucent than the cryst
(138) it is principally of an apple-green colour, and is so

of a radiated structure. It is met with in considerable beds in mountains of micaceous schistus, gneiss, and serpentine. At Grenier in the Tyrol, it occurs in a species of serpentine, accompanied by actynolite, carbonate of lime, sulphuret of iron, green mica, &c. At Zillerthal, in the Tyrol, it is met with enclosing long prisms of actynolite, and of tourmaline. It occurs also in Austria, Stiria, &c.

In Britain, talc is found in Scotland in Glen Tilt, in Perthshire, in a granular limestone: also in Banffshire and Aberdeenshire.

It occurs in a greenish-grey colour, with compact felspar, at Old Lizard Head, in Cornwall, which is a serpentine ntry; a bed of talc underlies serpentine in Kynan's Cove, rnwall: another occurs between serpentine and clay-slate r Porthallo, Cornwall.

durated talc is massive, of a greenish-grey colour; the structure is schistose and curved; it is of a shining, or sometimes of a pearly lustre, and somewhat translucent. It is soft and somewhat unctuous to the touch. Spec. grav. 2.9. DXIX (139)

It occurs in primitive mountains in clay-slate and serpentine, in several countries of the Continent of Europe. CCLXI (140)

In Britain, in Perthshire and Banffshire in Scotland, and in the Shetland Islands. It is said also to occur at the Lizard in Cornwall.

GREEN EARTH.

Grünerde W. Talc Zographique H.

This mineral is met with in small masses in, or lining the vities of, amygdaloid; and is of a greyish or bluish-green cor, passing into blackish-green; it is dull, and yields to the l: its fracture is generally earthy. It is found wherever ygdaloid occurs; as in Saxony, Bohemia, Monte Baldo near rona and in Faroe. That of Verona consists of 53 of silex, f magnesia, 10 of potash, 28 of oxide iron, and 6 of water. hen of a good colour it is made some use of by painters. CCLXXI (141

In Britain, it occurs in the Hill of Kinnoul near Perth. The all greenish masses in the sand lying beneath the chalk of gland (the green sand), are considered to be a variety of mineral.

SOAPSTONE.

Speckstein W. Talc Steatite H.

XII (142) The Soapstone is found massive, and nearly white or of a colour, sometimes with a tinge of yellow, and mottled green or purple; when first raised it may be kneeded dough, but by exposure loses a part of its moisture, and is translucent on the edges, yielding to the nail, and posse an unctuous feel.*

It is met with in a vein in serpentine at the Lizard poi Cornwall, where it may sometimes be found with the appea of passing into asbestus, which occurs in veins in the serpen another vein has been observed near Mullyan Church T It is much used in the manufactory of porcelain, at Swanse Wales. It also occurs near the Cheesewring, at St. Clee Cornwall.

The soapstone of Cornwall consists of 45 per cent. of s 9.25 of alumine, 24.75 of magnesia, 0.75 of potash, 1 of c of iron, and 18 of water. It is commonly supposed to variety of steatite, but is much softer. In the compositio the steatite no alumine has been detected, and it is infus whereas the soapstone fuses into a white enamel. It somet includes veins of asbestus.

1. STEATITE.†

Speckstein W. Talc Steatite H.

XIII 143) Steatite is of various shades of white, grey, yellow, green, red; and is met with massive, and (in Franconia) with occ nal appearances of crystallization; which, being mostly, i always, referable to the forms assumed by quartz or carb of lime, are therefore in varieties which cannot originate i same primitive form, and are thence considered to be *pseudomorphous.*

This substance has generally an unctuous feel; it yiel the nail, but does not adhere to the tongue; its fractu splintery, sometimes slaty: it is somewhat translucent o edges: it hardens before the blow-pipe, and becomes black is infusible. Steatite consists, according to Vauquelin, (silex, 22 magnesia, 3 oxide iron, and 5 of water. Its grav. is 2.67.

Steatite is found in considerable masses, or in beds or v in some primitive mountains. It is most common in serpe At Freyberg in Saxony, it is met with in tin veins; where accompanied by, or mingled with, mica, asbestus, quartz, and occasionally native silver, &c. It abounds in the principality of Bareuth, in Saxony; it is also found in Bohemia, Norway, Sweden, and France; and in Maryland, Pennsylvania, and Connecticut, in North America.

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* Whence its name of Soapstone.

† From a Greek work, signifying Soap, in allusion to its greasy feel

It is found at Portsoy, in Scotland, in serpentine, and in the Isle of Sky and others of the Hebrides, in wacké.

It occurs also in the Isle of Anglesey.

The white varieties, or those that become so by calcination, are employed in the manufactory of the finest porcelain: other varieties are said to be used for fulling. The Arabs, according to Shaw, use steatite in their baths instead of soap, to soften the skin; and it is confidently asserted that the inhabitants of New Caledonia either eat it alone, or mingle it with their food. Humboldt says, that the Otomaques, a savage race inhabiting the banks of the Oronoko, are almost entirely supported during three months in the year, by eating a species of steatite, which they first slightly bake, and then moisten with water.

2. POTSTONE.

Topfstein W. Talc ollaire H. Pierre ollaire Br. Serpentine ollaire Bt.

This substance is found massive; and it is sometimes difficult CCCXLVI to distinguish it from massive talc; its colour is greenish grey, passing into leek-green, with a glistening or pearly lustre; it is (144 so soft as to yield to the nail, and is unctuous to the touch, but is not easily broken; that of Chiavenua consists, according to Wieglib, of about 38 parts of silex, 7 of alumine, 35 of magnesia, 15 of iron, together with very small portions of lime and fluoric acid, but a variety analysed by Tromsdorff, was without alumine, and yielded 20 per cent. of carbonic acid.

Potstone is plentifully found at Chiavenna, in the Valteline; at Coma, in Lombardy; and, generally speaking, in serpentine countries. Its infusibility, joined to its softness, and the readiness with which it is turned by the lathe, have from time immemorial caused it to be formed into vessels* in the Valais and Grisons. Pliny describes its having been used in like manner in his time.

It also occurs in Norway, Finland, and Greenland.

3. AGALMATOLITE.

Bildstein W. Talc graphique H. Steatite pagodite Bt.

It occurs massive, and sometimes with an imperfectly slaty ℰLXXXV structure; its general colour is mostly greenish, or yellowish 4 green, with veins of blue or brown; it is sometimes brown; or bluish; is translucent on the edges, unctuous to the touch, and generally yields to the pressure of the nail. Its spec. gravity is 2.8. It consists of 56 of silex, 29 of alumine, 2 of lime, 7 of potash, 1 of oxide of iron, and 5 of water. Vauquelin. In the varieties of the Chinese, analysed by Klaproth, no indication of potash was found, and one of them was without lime. Brongniart has given it the name of steatite pagodite, from its being always brought from China in the form of little grotesque figures* and chimney ornaments, but all the analyses of it distinguish it sufficiently from steatite, which is always in part constituted of magnesia. The agalmatolite is also found at Nagyag in Transylvania. Before the blowpipe on charcoal it whitens with heat, and presents some marks of fusion at the extremity of the projecting part; with borax affords a colourless glass.

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* Whence the name of Potstone.

In Wales, at Glyder Bach, Caernarvonshire.

CHLORITE.

Chlorite W. Talc Chlorite H.

Chlorite is found crystallized, compact, slaty, and earthy. It is usually of a dark green,† sometimes of a yellowish green, or of a greyish colour, with a shining lustre; it is opake, yields to the nail, is somewhat unctuous; and when massive, gives out an earthy smell when breathed on.

Crystallized chlorite occurs in flat six-sided prisms, which are readily divisible into thin laminæ, parallel with their terminating planes; the lustre is shining and between pearly and resinous. It occurs both in separate crystals and in small masses investing other substances, in which the crystals intersect each other variously.

It occurs chiefly in the veins and cavities of primitive rocks; sometimes it is enclosed in crystals of quartz, chalcedony, felspar, axinite, &c. in so large a proportion as to impart a colour to them; sometimes invests their surfaces. It frequently accompanies the oxide of tin and mispickel in the veins of Cornwall; and occasionally, though rarely, yellow copper. It is met with in most chains of primitive mountains.

Compact chlorite, is amorphous, scarcely glimmering, and of an earthy texture.

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* Whence also the name of Agalmatolite, from the Greek.

† Whence Chlorite, from the Greek, signifying green.

It occurs in beds and veins of granite, &c. and sometimes disseminated in it, as in that of Mont Blanc: it occurs in Saxony, &c.

In Britain: in veins traversing clay-slate in Arran, Bute, &c. in Scotland; with copper in the Wherry mine, with tin in Relistian, and in several other mines in Cornwall.

Chlorite-slate possesses a glistening lustre, and slaty structure. CCCCXV
It is found in St. Gothard: in Salzburg, Sweden, Corsica; (145)
and in Jura, one of the Hebrides.

Earthy chlorite consists of scaly particles, which are slightly coherent or quite loose. It consists of 26 silex, 18.5 alumine, 8 magnesia, 43 oxide of iron, 2 muriate of soda, CCCXXIV or potash. Vauquelin. Before the blow-pipe, chlorite (146 fuses into a black globule with a dull surface; with borax easily into a dark green glass.

It occurs in the tin veins of Cornwall.

SCHORL.

Gemeiner Schörl W. Tourmaline opaque & noire H.

Schorl is found massive, disseminated, and crystallized; the CCCLXXXI common form of the crystals is a prism mostly striated longi- (14 tudinally and deeply, rarely terminated at each end by three planes; but the crystals are sometimes very minute, closely aggregated, and divergent. This substance is brownish black, CCCXC brittle, has a glistening lustre, and in the mass is opaque, but in (14 small fragments is sometimes of a yellowish green by transmitted light. Its specific gravity is about 3.2; it is composed of about 38 parts of silex, 34 of alumine, 1 of magnesia, 6 of CCCCLXX potash, 21 of oxide of iron, and a trace of manganese. Klaproth. (149

It is commonly ranged among tourmalines, from which it differs in respect of analysis, transparency, colour, and fracture. Tourmaline possesses a conchoidal fracture; that of Schorl is fine grained uneven. Tourmaline mostly occurs imbedded in single crystals; and Schorl is mostly aggregated, and occurs in beds.

It is found in primitive rocks; chiefly in quartz and granite; more rarely in gneiss and micaceous schistus; and is frequently CCCLXXV met with in tin veins. (15

Schorl was first found near the village of Schorlaw* in Saxony. It is also met with in Bohemia, Bavaria, Switzerland, Spain and Hungary; and in Asia and America.

In Scotland, it is found in Perthshire, Banffshire, Inverness-shire, and Argyleshire. In Cornwall, beneath the Logan rock near the Land's End; also in the tin veins of the county and sometimes in granite; it is the *Cockle* of the miner: in veins and imbedded in the granite of the east of Ireland.

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* Shorlaw, whence Schorl.

KILLINITE.

Killinite, Dr. Taylor.

This mineral is of a light green, which sometimes is tinged brown or yellow; but is often coated externally with a brownish or ferruginous appearance of disintegration, from the progress of decomposition resulting from exposure. It occurs massive, with the occasional appearance of prisms, rifted across, and irregularly disposed in regard to each other; one prism afforded by the common goniometer, angles of 135° & 45°. The structure is lamellar, yielding to mechanical division parallel to the lateral planes of a rhombic prism of 135° & 45°, and its lesser diagonal, but not parallel to its terminal planes; its lustre is glimmering; the cross fracture is fine grained. It is translucent, yields to the knife, and is easily frangible. The coating arising from exposure, yields an argillaceous odour when breathed on. Specific gravity 2.698. It consists according to the analysis of Dr. Barker, of silex 52.49, alumine 24.50, lime, magnesia, and oxide of iron 0.50, potash 5, oxide of iron 2.49, oxide of manganese 0.75, water 5. Before the blow-pipe, it loses its colour and becomes white, swells, and fuses into a white enamel.

This mineral was not long since discovered by Dr. Taylor in granite veins, near the junction of mica-slate with granite, at Killiney[*] near Dublin in Ireland. It is accompanied by spodumene, quartz, felspar, and garnet.

It resembles spodumene so greatly in external character and even in chemical composition, that future analysis will probably prove the alkali it contains is not potash, but lithia.

EUDYALITE.[†]

The Eudyalite occurs both massive and crystallized, but the crystals are generally very small, and so irregular, that their precise form has not been yet discerned. It may be cleaved into regular hexahedral prisms affording the measurement of 120° of one lateral plane on the next, and 90° of the summit on each lateral plane. The colour of the crystals is red or brownish red, and they are generally somewhat translucent. Analysis by Stromeyer, silex 53.325, zircon 11.102, lime 9.735, natron

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[*] Whence Killinite.

[†] Eudyalite, from the Greek, in allusion to its ready solubility in acids.

13.822, oxide of iron 7.754, oxide of manganese 2.062, muriatic acid 1.034, water 1.801.

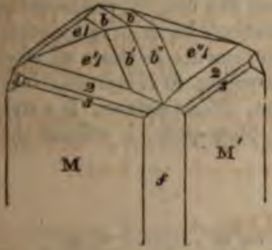
It is found accompanying the sodalite in Greenland.

MESOTYPE.*

Zeolith W. Mesotype H. Var of Zeolite J.

This mineral occurs crystallized, fibrous (radiating) and pul- CCLXV.
verulent (Mealy Zeolite): the two former are of a shining (151
lustre; the crystals are in the form of a slightly rhombic prism
terminated by pyramids. It cleaves parallel only to the sides CCLXV
of a prism of 91° 20′ and 88° 40′, by the reflective goniometer
from planes of cleavage; it is white or greyish white, and the (15
crystals are transparent or translucent; it yields to the knife,
but scratches calcareous spar. Its specific gravity is 2. It is DXXII
composed according to Vauquelin of 50.24 silex, 29.3 alumine,
9.46 lime, and 10 water. Smithson found 17 of soda, which (153
was not discovered by Vauquelin by the analyses of several
specimens sent to him by Haüy; nor was it found by Pelletier.
Analysis by Gehlen, silex 54.46, alumine 19.70, lime 1.61,
soda 15.09, water 9.83.

In large crystals, before the blow-pipe on charcoal, it becomes opaque, and then vitrifies without intumescence; with borax, fuses with difficulty.



M on M′	91°.20′
M on e′1 or M′ on e″1	116 .56
M on e′2	117 .24
e′1 on e′2	179 .32
e′ on e″1	143 .33
e1 on e′1	142 .33
b′ on b″	146 .23
e′2 on e″2	142 .38

The *fibrous* variety consists of minute crystals aggregated in a radiating or stellular form: the centre being often compact enough to yield a splintery fracture, while the surrounding part is soft and apparently decomposing: these masses are sometimes globular.

The earthy or *pulverulent* variety (Mealy Zeolite J.) occurs in soft, dull, friable masses, having an earthy fracture, and a rough and meagre feel. It is of a white, greyish or reddish colour.

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* Mesotype, signifying a 'mean form' between stilbite and analcime!

Mesotype is found in Iceland; Scotland; the Faroe i in Hessia; the Isle of Bourbon; Auvergne; also in the and in North America. It is found in lavas, but princip not only, in those that are ancient; and, it is said by only in such as have been exposed to the action of wat is also met with in basalts; as in those of the Cyclop I and of the Vicentine mountains; the basalt of the two l surrounded and covered by the remains of sea animals.

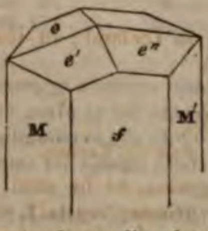
In Britain, the mesotype also occurs in basalt, amyg or other trap rocks of England, Scotland, and Ireland. particularly abundant in Talisker, in the Isle of Sky, panying analcime in the cavities of trap rocks, which af the varieties: in the basalt of Staffa, and the trap r Scotland. It also occurs at Cave hill near Belfast; in Antrim; in the basalt of the Giant's Causeway in Irelai has been found in England in the decomposed trap of hill in Staffordshire, occasionally attached to prehnite.

I. NATROLITE.*

Natrolith W. Natrolite H. Ekebergite.

CXXV
49

It occurs in mamillary masses, which when broken a fibrous structure; the fibres are diverging, of a pearly and are white, or of yellowish or reddish brown disposed in alternate zones around the centre; in the cavi on the surface of which, may sometimes be observed minu tals of the same forms and measurements as those of me Its specific gravity is 2.2. According to Klaproth, it posed of 48 silex, 25.24 alumine, 16.50 natron, 9 wat 1.75 oxide of iron. Before the blow-pipe, it affords tl result as Mesotype.



M on M	91°.35′
M or M′ on f	135 .35
M on e′ or M′ on e″	116 .50
e′ on e″	143 .35
e′ or e″ on f	109 .18

It occurs in small veins in a porphyritic rock at Rog the lake of Constance; also at Klingstone near Hohent Swabia.

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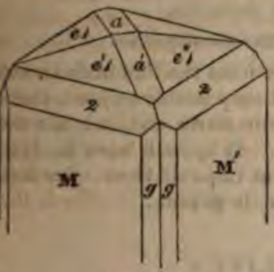
* Natrolite, from its containing Natron.

In Scotland, according to Jameson in the trap-tuff hill named the Blin, behind Burnt-island, and in the trap-rocks of the islands of Mull and Sky.

2. NEEDLESTONE. MESOLITE.

Mesolite, Fuschs & Gehlen.

It occurs massive, and also in long slender prisms terminated by quadrilateral pyramids. It cleaves parallel to the sides of a very slightly rhombic prism, agreeing in measurement with that of Mesotype; there is also a remarkable agreement in some of its secondary planes with those of that mineral, of which it cannot be doubted that it is only a variety. The prisms are translucent or transparent and colourless, or of a greyish colour, externally shining with a somewhat pearly lustre. Specific gravity 2.26, analysis by Fuschs and Gehlen, silex 47, alumine 25.9, lime 9.8, soda 5.40, water 12.30. Of that of Pargas by Berzelius, silex 45.8, alumine 26.50, lime 9.87, soda 5.40, water 12.30. Before the blow-pipe, it becomes opaque and curls up, and finally melts with the extrication of air bubbles into a porous and almost opaque bead.



M on M′	91°.22′
M on e′1 or M′ on e″1	117 .10
M on e′2 or M′ on e″2	146 .38
M on g	162 .30
e′1 on e″1	144 .15
e′1 on e1	142 .10
e′1 or e″1 on a′	162 .15
e″1 on e′2	150 .42

It occurs at Pargas in Finland; in Iceland; in the Faroe isles with Stilbite, and in the Tyrol.

SOMMITE.*

Nephelin W. Nepheline H. Sommit, Karsten.

E. VIII
50

The Sommite usually occurs in grains, or in small regular hexahedral prisms (the form of the primary crystal), of which the terminal edges are sometimes replaced. It may be cleaved parallel with all the planes of that solid; its cross fracture is conchoidal. It is of a greyish or greenish white colour, with a

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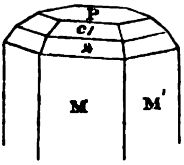
[*] Sommite, from its being found on Monte Somma.

shining vitreous lustre, and scratches glass. The Sommite considerably resembles phosphate of lime, but may be distinguished by its superior hardness, and by its not giving a phosphorescent light when placed on a live coal. Its specific gravity is about 3.2. Analysis by Arfwedson, silex 44.11. alumine 33.73, soda 20.46, loss 0.62. Before the blow-pipe, it is fusible into a blebby colourless glass. When immersed in nitrous acid, it becomes cloudy internally, whence the name Nepheline, from νεφελη, a cloud; and is finally converted into a jelly.



M on M'	120°.—
P on M or M'	96 .—
P on c1	151 .53 H
——— c2	135 .40
M on c1	118 7 H
——— c2	134 .20

It has been found in the cavities of a granular limestone of that part of Vesuvius called Mont Somma, where it is accompanied by mica and idocrase: it occurs in the lava of Capo di Bove, near Rome.

1. PSEUDO SOMMITE.

Pseudo Sommite. Fleuriau-Bellevue.

This substance scarcely differs from the Sommite in external characters, and principally if not only in this respect, that when reduced to powder and thrown into nitric acid, it is not thereby reduced into the form of a jelly. It has not been analysed.

It occurs with the Mellilite at Capo di Bove near Rome in a compact lava with which Rome is paved.

RUBELLITE.*

Var. of Tourmaline H. Tourmaline rubellite Bt. Var. of Tourmaline J. A.

XXIX
51

The Rubellite, as its name imports, is of various shades of red, from a slight tinge to a fine pink; it is sometimes of a violet colour. It occurs in crystals which rarely are distinct, being commonly closely aggregated; and sometimes enclosed in those of green tourmaline. It consists of 42 per cent. of silex, 40 of alumine, 10 of soda, and 7 of oxide of manganese and iron. It is commonly considered to be a variety of tourmaline, from which it differs in its constituent elements. Alone on charcoal before the blow-pipe it turns milk white, intumesces, splits,

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[*] Rubellite, from its red colour.

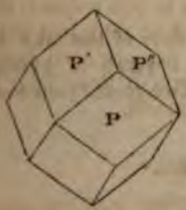
and does not fuse, but vitrifies on the edges; with borax affords a transparent glass. This mineral is commonly known by the name of *Red Schorl.*

It is found accompanying Lepidolite at Rozena in Moravia; in Ceylon; it occurs in a granite mountain in the Uralian chain in Siberia, in a vein composed of felspar, quartz, mica, and common schorl; whence this mineral has been also called *Siberite.*

It is also found in Massachusetts in North America in granite, containing also green tourmaline, indicolite, and emerald.

SODALITE.[†]

Its colour is light green, or bluish green, and it occurs massive, but more often crystallized in rhombic dodecahedrons E. XL 52 parallel to the planes of which it yields to mechanical division, as well as parallel to the planes of the cube; the cross fracture is commonly conchoidal, with a vitreous lustre. It is translucent, and yields with difficulty to the knife. Its specific gravity is about 2.37; and according to the analysis of Thomson, it is composed of 38.42 of silex, 27.48 of alumine, 2.70 of lime, 23.5 of soda, 3 of muriatic acid, 1 of oxide of iron, and 2.1 of volatile matter. Alone before the blow-pipe on charcoal it suffers no change, except that its edges become rounded; with borax it affords a transparent colourless glass with extreme difficulty.



P on P′ or P on P″ } 120°00′
or P′ on P″ .... }

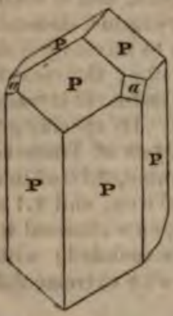
This rare mineral has been found in mica-slate associated with sahlite, augite, hornblende, and garnet, in Greenland: and on the slope of Vesuvius accompanied by pyroxène, and ice-spar.

SPINELLANE.

Spinellane H. Nosin, Leonhard.

It occurs in very small crystalline masses, and in minute crystals which are mostly dull externally, but by transmitted light E. XCIV 53 are translucent, of a yellowish colour, occasionally with a tinge of blue. The crystals are in the general form of six-sided prisms with triedral terminations, but in reality are rhombic dodecahedrons, their prismatic appearance being derived from a somewhat singular elongation of six of the planes of that solid, parallel to the planes of which the crystals yield to mechanical division with brilliant surfaces, affording the angles of 90° & 120° by the reflective goniometer; and hence the rhombic dodecahedron may be considered as the form of the primary crystal. Analysis by Klaproth, silex 43.10, alumine 29.5, lime 1.5, natron 19, oxide of iron 2, water 2.5. It scratches glass, but is brittle. Under the blow-pipe it whitens, and readily melts into a white blebby enamel.

[†] Sodalite, from its containing soda.



P on any adjoining plane P	120°00′
a on *a*	90.00
a on any adjoining plane P	135.00

It has only been found on the borders of the lake of Laach, in a rock composed of grains and crystals of glassy felspar, quartz, hornblende, black mica, and magnetic iron ore in small octohedrons.

LYTHRODES.*

Lythrodes, Karsten.

This mineral is found massive and disseminated: it is of various shades of red, brownish and yellowish red, occasionally with greenish or yellowish spots. Its structure is imperfectly foliated, yielding to cleavage parallel apparently to the planes of a slightly rhombic prism, with oblique summits, but not with sufficient precision for the use of either goniometer with accuracy. It has a glimmering or resinous lustre; the cross fracture is splintery and dull. It is slightly translucent on the edges, and considerably hard. Its specific gravity is 2.5. It consists of silex 44.02, alumine 37.56, lime 2.75, soda 8, water 6, oxide of iron 1.

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* From its spotted appearance, when newly broken.

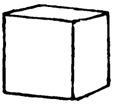
It occurs at Fredrickswarn and Laurwig in Norway.

ANALCIME.

Zubizit W. Analcime H.

Analcime is met with in nodules, in aggregated crystals in the CLXI (154
form of minute diverging fibres, or in cubic crystals, either perfect, or having each of the solid angles replaced by three planes. The cube is the primary crystal, there being occasional appearances of cleavage parallel to the planes of that solid; the fracture is flat conchoidal; LIX (15
the lustre is shining, and between pearly and vitreous. The colour of analcime is white, grey, yellowish, reddish, or deep red; it is hard enough to scratch glass, and is LVIII (15
mostly transparent or translucent, occasionally opaque; it becomes weakly* electric by rubbing. Its specific gravity is below 2. It consists of 58 of silex, 18 of alumine, 2 of lime, 10 of soda, and 8.5 of water. Vauquelin. Alone on charcoal, be- LVII (15
fore the blow-pipe, it becomes transparent, and then fuses without intumescence into a diaphanous glass.

1



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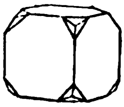

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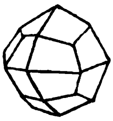
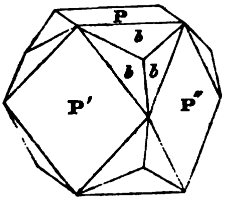


Fig. 1. The primary; a cube. Fig. 2. the same, of which each solid angle is replaced by three planes, thereby adding twenty-four planes to it. Fig. 3. represents a crystal on which these twenty-four planes are increased to their utmost extent, so that no part of the primary planes is visible, and forming a crystal bounded by twenty-four equal and similar trapeziums.



	Haüy.
P on P′ or P″ or P′ on P″	90°.— —
P P or P″ on *b*	144 .44′. 8″
b on *b*........	146 .26.33

It occurs in granite and gneiss, in trap rocks and lavas.

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* Whence Analcime, from the Greek, in allusion to the feebleness of this property.

It is found in the Hartz, in Bohemia, Iceland, and the Fa Islands; at Oberstein in geodes.

In Scotland, it occurs in trap rocks at Kirkleston, n Edinburgh; also in Kilpatrick hills in Dunbartonshire; n Beith in Ayrshire; in Perthshire; in abundance near Talisl in Sky; in trap rocks accompanied by mesotype in the bas of Staffa. In Ireland, in Benyavenagh in wacké, and at C hill near Belfast,

A variety called the *Sarcolite*, from its being of a flesh- colour, is met with on Somma, in cubes, having each solid an replaced by three planes; and at Calton hill near Edinbu in the form of the cube.

CLINKSTONE.

Klingstein W. Pierre sonnante Br.

The Clinkstone is always found massive, with an imperfec slaty structure; when struck with a hammer, it gives a ring metallic sound.* It is of a dark greenish, yellowish, or grey colour: has an even, or slightly conchoidal fractu yields with some difficulty to the knife, is brittle, and c monly translucent on the edges. Its specific gravity is 2. and it consists of silex 57.25, alumine 25.50, lime 2.75, s 8.1, oxide of iron 3.25, oxide of manganese 0.25, and water. Klaproth.

The clinkstone is usually columnar, and frequently rests u basalt. It occurs near Zittau in Upper Lusace; in the Bo mian Mittellgebirge; in South America; in the island of L lash in the firth of Clyde, the isles of Mull and Arran, Ochil and Pentland hills in Scotland; the Breidden-hills Montgomeryshire, and in the Dirris mountain in the co of Antrim in Ireland.

PITCHSTONE.†

Pechstein W. Petrosilex resinite H.

DVIII The colours of this mineral are very various shades of g
(158 blue, green, yellow, red, brown, and black, but they are
lively: it is met with massive, and in prismatic concretion
CCLVI which the structure is sometimes slaty, occasionally cur
(159) the massive has a glistening resino-vitreous lustre, and an
perfectly conchoidal fracture, which in some varieties is
CCLVII chief characteristic distinction between pitchstone and
(160) dian; and it is not unfrequently confounded with horns

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* Whence Clinkstone.

† From the resemblance of some of its varieties to pitch.

and semi-opal. It is almost always opaque, or only translucent on the edges; it scratches glass. The specific gravity of that of Meissen in Saxony, is 2.32—2.64. Pitchstone is composed of 73 per cent. of silex, 14.5 of alumine, 1 of lime, 1.75 of soda, 1 of oxide of iron, 0.1 of oxide of manganese, and 8.5 of water. Klaproth. Analysis of that of Newry by the Hon. Mr. Knox, silex 72.80, alumine 11.50, lime 1.2, soda 2.85, protoxide of iron 3.036, water and bitumen 8.50. By exposure to a strong heat, that of Newry is convertible into a cellular substance resembling pumice. Pitchstone is sometimes fusible before the blow-pipe into a grey enamel.

The pitchstone of Meissen, of which the analysis is given, is of a yellowish grey colour, and alternates in the mountain of Geresbach between Meissen and Freyberg, with a porphyry having a base of petrosilex, which alternates with gneiss, and is traversed by metalliferous veins.

It is found in granite and other rocks termed primitive, also in various trap rocks of doubtful origin, and in lavas.

In Scotland, it occurs in granite on the summit of Cairngoram; it traverses granite in the form of veins in the isle of Arran. In trap rocks in Sky, Canna, and Mull. In Ireland, it occurs in a vein parallel to one of basalt, traversing granite, near Newry in the county of Down.

LAVA.

Lava is externally yellowish or greenish grey, greyish black, or greenish black, and is internally spotted reddish, yellowish brown or grey; sometimes, when sulphureous vapours have acted much upon it, it is yellowish or sulphur yellow. It is vesicular and knotty; the vesicles are empty; sometimes it is porous. Its fracture is imperfectly conchoidal; internally its lustre is glistening or shining. It is opaque or translucent on the edges, brittle, mostly attracts strongly the magnetic needle, and, it is somewhat remarkable, is easily fused into a black glass. The compact lava of Calabria yields, by analysis, about 51 of silex, 19 of alumine, 10 of lime, 4 of soda, 14 of iron, and 1 of water.

Lava sometimes encloses crystals of augite, hornblende, felspar, and leucite; which occasionally have no appearance of having been altered by heat.

The above description, generally speaking, belongs to those substances, which, by common consent, are true lavas; the products of Etna, Vesuvius, Hecla, and other Volcanoes. But there are many substances, considered by some mineralogists as lavas, which, by others are not allowed to be of volcan origin. Karsten enumerates nine species of lava; and Hai six, which are again subdivided; amongst them are pearlsto and obsidian. Werner notices only two, one of which he ca *Slag Lava*, the other *Foam Lava.* The slag lava is abo described; foam lava is of a greenish grey colour, approachi to greenish black; it is light, brittle, and often crumbling; a has often been confounded with pumice. *Puzzolana* is d composed lava; the cement used in constructing the Edysto lighthouse, was composed of equal parts by weight of slack lime and puzzolana.

BASALT.

Basalt W. Lave lithoïde basaltique H.

Basalt occurs amorphous, columnar, amygdaloidal, and v
cular. It generally appears of a granular texture; its fractu
CCLXVIII is uneven, occasionally somewhat conchoidal; it is opake,
(161) nearly so, yields to the knife, and is difficulty frangible.
specific gravity is about 3. That of Saxony is composed of 4
per cent. of silex, 16.75 of alumine, 9.5 of lime, 2.25 of ma
nesia, 2.6 of soda, 20 of oxide of iron, 0.12 of oxide of mang
CCLXIX nese, and 2 of water. It easily fuses into a black glass.
(162) It is found in beds and veins in granite and mica slate, t
old red sandstone, limestone, and in coal formations.

It occurs abundantly in North and South America, in t islands of Teneriffe and St. Helena, in the Faroe islands a Iceland; largely in Germany, France, England, Scotland, a Ireland. That of Germany is believed by the geologists of t country to be of neptunian origin; that of France is now u versally acknowledged to be volcanic.

In England, basalt is interstratified with or traverses dykes, the limestone and sandstone of its coal measures; a traversing coal, which in some instances, when in contact w the basalt, appears to have been reduced to a cinder or sm In others no effect has been produced. The basalt of Teesd includes olivine and greenish black augite. In Derbyshi toadstone, which occasionally agrees with basalt in charact is interstratified with limestone, on which it appears not have had any effect: and in several other places in England greenish rock called trap or greenstone is connected with coal fields.

In Scotland, it occurs, says Jameson, in considerable ab dance, but is more so in the south and middle parts than in northern parts of that country. Dr. Mac Culloch observed Cruachan perfectly characterized veins of basalt in granite.

In Ireland, basalt occurs in the northern parts covering a district of great extent, lying in many instances on chalk; and intersecting it as a dyke, by which the chalk seems to have been converted into granular limestone; the Giant's Causeway forms a part of this tract. At Newry in Downshire, traversing granite.

Basalt is sometimes *amygdaloidal*. This is not often found in the columnar form; but is amorphous, and encloses zeolites of various sorts. It is so found in Staffa, imbedding masses of mesotype and analcime from the size of a pea to that of a hen's egg; and more rarely chabasie. The amorphous basalt of Ireland includes olivine: the columnar encloses steatite.

Decomposed basalt is used as a cement, and is termed *Tarras;* two parts of slacked lime and one of tarras, form the principal part of the mortar used in the Great Dykes of Holland.

PUMICE.

Bimstein. W.

Pumice is extremely porous, of a fibrous texture, and harsh to the touch; its colour is grey, tinged with brown or yellow; it has a shining pearly lustre, and is translucent on the edges, very light, and sometimes so light as to swim on water. It is composed of 77.5 parts of silex, 17.5 of alumine, 1.75 of oxide of iron, and 3 of soda and potash. It fuses into a dirty green glass full of bubbles.

Pumice is generally believed to be a volcanic product; it sometimes accompanies obsidian; it is said that the vitreous obsidian of Hungary, may by heat, be changed into a substance perfectly resembling pumice; as may also the pitchstone which traverses granite at Newry in Ireland.

It is but sparingly found near Vesuvius, not at all near Etna. It is very abundant in the Lipari islands, which furnish the pumice of commerce. It is met with in Auvergne in France, in Iceland, Teneriffe, &c. In the latter place small veins of carbonate of lime were observed traversing it.

Pumice is sometimes *porphyritic*, that is to say, it is occasionally found containing crystals of felspar, quartz, mica, and augite.

COMPACT FELSPAR.

Dichter Feldspath W. Feldspath compacte ceroide H.

It occurs in masses which do not possess any regular structure, but which have a slightly granular texture and a glimmering or waxy lustre; it is extremely hard. Its specific

gravity is 2.63. It is composed of silex 68, alumine 19
potash 5.5, oxide of iron 5.5; water 2.5; Godon de St.
but Dr. Mac Culloch observes that compact felspar
potash and soda; and that both these alkalies are fou
in whatever situation it exists; whereas common felspar
only potash.

It is pretty largely found both in primitive and se
rocks, and in most countries.

In Britain; it occurs in Scotland in beds in transitio
the Pentland and Ochil hills; in Dumfries-shire and G
in Aberdeenshire, &c. In England, it is said, in the
hills; in Shropshire; and with green talc at the Old
Head in Cornwall. In Ireland in beds in Gleuteigue h

JADE.

The general characters of Jade, of which there a
varieties, are, that it always occurs massive, of various s
green and whitish green, with a greasy lustre, and is
translucent on the edges; it is unctuous to the touch,
tough, but there is much obscurity and some contradi
the description of these minerals.

1. COMMON JADE. NEPHRITE.*

Gemeiner Nephrit W. Jade nephritique H. Common Neph

Common Jade is of a leek green colour, passing into
white, semi-transparent, extremely tough, with a gli
lustre, and broad splintery fracture: it scratches qua
specific gravity is 2.95; and it is composed of 53.75
1.5 of alumine, 12.75 of lime, 8.5 of potash, 10.75
5 of oxide of iron, 2 of oxide of manganese, and 2.25 o
Saussure. On charcoal, before the blow-pipe, it fuse
white glass with difficulty; with borax into a transpare

In Switzerland, it occurs in granite and gneiss; in th
in greenstone. It is also found in Persia, Egypt, Siberia
and North and South America.

2. AXE-STONE.

Beilstein W. Axe-stone J.

The Axe-stone differs from common jade in being o
light a green; it is sometimes greenish grey: also in
somewhat slaty structure, and in being less transparent
tough.

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* Nephrite, from its being regarded in India as a specific for the
cholic.

In America it is found in the banks of the river Amazons; whence it obtained the name of the *Amazonian stone.* It is also met with in Corsica, Switzerland, and Saxony; and in New Zealand and other islands in the Pacific ocean, where it is made into hatchets, and other instruments.*

3. SAUSSURITE.

Jade Tenace H.

Its colour is leek-green, passing into glaucous green and greenish white: it is said also to occur of a grey colour. It scratches quartz, is translucent on the edges, unctuous to the touch, and extremely tough. Its specific gravity is 3.26. According to Saussure it consists of 44 parts of silex, 30 of alumine, 4 of lime, 0.25 of potash, 6 of soda, 12.5 of oxide of iron, and 0.5 of manganese.

It was first discovered by Saussure,† in rounded masses on the edge of the lake of Geneva, and afterwards near Turin, in the mountain Mussinet, which is principally composed of serpentine.

It occurs at Coverack Cove in Cornwall in serpentine, and is accompanied by diallage.

OBSIDIAN.

Obsidian W. Lave Vitreuse obsidienne H.

Obsidian occurs in beds, in large masses, and in small grains; it is of a greenish or brownish black, or of a smoke brown colour; it possesses internally a shining vitreous lustre; its fracture is large conchoidal; some varieties are translucent, others are nearly opaque, or only translucent on the edges; it is hard enough to scratch glass, but is very brittle: its specific gravity is about 2.35. That of Hecla yields by analysis 78 of silex, 10 of alumine, 1 of lime, 6 of potash, 1.6 of soda, 1 of oxide of iron. It occasionally very much resembles common glass.

The origin of obsidian has been very warmly contested; it is most common in the neighbourhood of volcanoes, and has been considered as a vitrified lava; whence it has obtained the familiar name of *Volcanic glass.*

It occurs on Hecla, and in almost every part of Iceland: it is also found in the Lipari islands; some varieties enclose felspar. In Peru it is met with in parallel beds of a greenish black, and greyish colour; the latter enclosing opaque, spherical masses of a slate colour, composed of diverging fibres. In New Spain, some obsidians, which have been long exposed to the air, are covered by a white opaque enamel.

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* Whence Axe-stone.

† Whence Saussurite.

Obsidian, of a greenish black colour, constitutes the greater part of the mountain della Castagna, in the island of Lipari; it encloses small crystals of felspar; and near the peak of Teneriffe obsidian occurs in the form of considerable currents, (like lava) presenting some fibrous appearances, denoting its passage into pumice.

A variety of a silky and chatoyant lustre is also found in New Spain. At Real del Monte Mexico.

In the island of Ponce, obsidian is met with, enclosing yellow mica, and white vitreous grains which appear to be semi-vitrified felspar.

Obsidian is in some places traversed by veins of stony or earthy matter of various kinds: thin beds of which also occur between beds of obsidian. In the Madona mountain, in the island of Ponce, the beds are nearly vertical. In Hungary, obsidian occurs intermingled with the debris of decomposed granite, gneiss and porphyry; and even alternates with beds of the latter. These circumstances have induced some mineralogists to doubt the igneous origin of obsidian; but their strongest arguments are—the violent intumescence which it undergoes when subjected to heat, which causes it to melt into a glass, and the quantity of aqueous vapour disengaged during the process. Humboldt suspects this to be one of the causes of the violent earthquakes so often felt in the Cordilleras of the Andes.

But it is said that wherever obsidian is found, there exist indications of volcanic agency in the neighbouring country.

In Europe, obsidian has been fashioned into reflectors for telescopes; in Mexico and Peru, it was made into looking-glasses and knives.

1. MAREKANITE.

Obsidian in the form of little grains of the size of peas, of a pearly white, and consisting of very thin concentric layers; together with fragments of these; also vitreous spheres of the size of a nut, and others like enamel, traversed by red and black veins; forming altogether a species of vitreous sand, is found at Marekan* in the Gulph of Kamschatka. It possesses in general the characters of obsidian.

FETTSTEIN.

Fettstein W. Elaeolith. Klaproth.

It occurs massive, and of a darkish green, bluish grey, or flesh red colour; it possesses natural joints parallel to all the planes, and both diagonals of a right rhombic prism, of about

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* Whence Marekanite.

112° and 68°; it is translucent, is of a lustre between vitreous and resinous, sometimes greasy,* and is occasionally slightly chatoyant; it scratches glass. Its specific gravity is 2.6; and, according to Vauquelin, it is composed of 44 of silex, 34 of alumine, 0.12 of lime, 16.5 of potash and soda, and 4 of oxide of iron. Alone on charcoal before the blow-pipe, it fuses into a blebby colourless glass.

It occurs only in Norway, at Laurwig, Stavern and Friederickswärn, in sienite.

SCAPOLITE.†

Scapolith W. Paranthine H.

Scapolite occurs in prisms of four or eight sides, sometimes terminated by tetrahedral pyramids; they are often aggregated laterally. The crystals yield to cleavage parallel to the sides, terminal planes, and both diagonals of a square prism. It also occurs massive. Its colours are grey or yellowish; or an almost metallic grey; sometimes deep red and opaque; or various shades of green. It has a shining or somewhat pearly lustre. It is translucent. The crystals possessing a pearly lustre will scratch glass; but when dull, with an appearance like that of efflorescing, they are tender and even friable. It is composed of 45 of silex, 33 of alumine, 17.6 of lime, 0.5 of potash, 1.5 of soda, 1 of oxide of iron and manganese; Laugier; but the efflorescing variety differs, in including some magnesia, and in being without potash. As the crystalline form of this mineral almost perfectly agrees with that of Wernerite, their identity will probably be proved by future analyses. Before the blow-pipe on charcoal, with a strong heat, it fuses with violent intumescence, into a colourless semi-transparent mass; with borax into a transparent glass.

E.LXVIII
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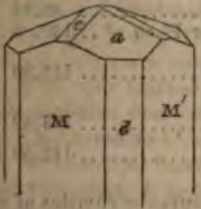

M on M	90°00′
M or M′ on *d*.	135.00
M on *a*	112.30
a on *d*	122.10

The scapolite has been met with in the iron mine of Langloe, at Arendahl in Norway, in gneiss; its crystals appear variously grouped; and are accompanied by brown mica, quartz, garı epidote, carbonate of lime, &c. It occurs also at various pla in Sweden, and in Greenland.

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* Whence Fettstein,—Fat-stone.

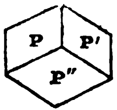
† From the prismatic form of its crystals.

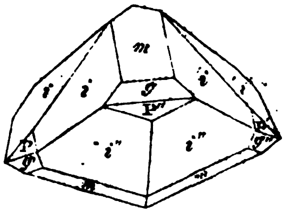
CHABASIE.†

Schabasit W. Chabasie H,

This mineral is found crystallized in the form of an obt
rhomboid of 94° 46′ and 86° 14′ by measurements on the pla
of cleavage with the reflective goniometer; it yields to r
XIV. chanical division parallel to the planes of the rhomboid, oc
(163) sionally with brilliant surfaces. The crystals are in the form
perfect rhomboids, or variously modified. The colour of c
CXV. basie is white or greyish, sometimes pale red superficially, a
transparent or translucent; it is scarcely hard enough to scra
(164) glass. Its specific gravity is about 2.7; and it consists, acco
ing to Vauquelin, of 43.33 of silex, 26.6 of alumine, 3.34
lime, 9.34 of potash and soda, and 21 of water; or, accord
to Arfwedson, of 43.38 silex, 19.28 alumine, 8.70 lime, 2.
potash, 21.1 water and loss. Alone it melts easily before t
blow-pipe into a spongy white enamel.

Primary.





P on P′	94°46′
P or P′ on P″	85.14
P on g′, P″ on g or P′ on g″	120. 5
P on i or i P′ on i′ or i′, or P″ on i″ or i″	175.30
i on i, i′ on i′ or i″ on i″	173.32
g on m	143.59 H

Chabasie is met with in the fissures or cavities of some basa rocks, or within geodes of quartz or agate which are disse nated in those rocks. It is thus found in the quarries of Alt berg, near Oberstein in Saxony. It is also said to occur in lavas of the Isle of Faroe; plentifully at Talisker in the Isle of Skye, in trap rocks of various kinds, accompanied by stilbite and analcime: at Glen Farg in Perthshire, and in the trap rocks of Portrush in the north of Ireland.

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† From the Greek, signifying a particular species of stone.

GABRONITE.

Gabbronit, Schumacher. Compact Scapolite J.

Gabronite occurs in compact masses, and it is said also in rectangular four-sided prisms, terminated by four-sided pyramids, of which the planes replace the solid angles of the prism. It is of a bluish or greenish grey colour, also reddish and red; its structure is lamellar, being mechanically divisible, though with difficulty, parallel, apparently to the sides of a rectangular prism; it is translucent on the edges, and hard enough to scratch glass, though not to give fire with the steel. Its specific gravity is nearly 3; and it is composed of 54 per cent. of silex, 24 of alumine, 1.5 of magnesia, 17.25 of potash and soda, 1.25 of the oxides of iron and manganese, and 2 of water. John. It fuses with difficulty into an opaque white globule.

It has only been found forming a vein in titaniferous iron near Arendahl in Norway. The bluish variety, near Arendahl, with hornblende; the greenish and red, at Fredericksvarn, disseminated in a large grained sienite.

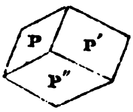
TOURMALINE.

Tourmalin W. Tourmaline H. Bt. Schorl Br.

It occurs both in semi-crystalline prisms of irregular form and
deeply striated on the surface, and in prisms of six or more sides, CCIX.
variously terminated, the two terminations being generally dis- (165
similar. It is of various colours, green, blue, (*Indicolite*), and
black; the green and blue being generally translucent in one CCX.
direction, and opaque in the other, the black altogether opaque: (16
externally the crystals are splendent, and they rarely exhibit
appearances of regular internal structure, the fracture in the DXLVI
more compact varieties being generally conchoidal. The pri- (16
mary form is considered to be an obtuse rhomboid of 133° 50′,
and 46° 10′. It is not so hard as quartz. One of its remark- CCCXX
able characters is, that it becomes electric when heated, the
termination which presents the greatest number of planes al- (168
ways exhibiting, according to Haüy, the positive or vitreous
electricity, while that which consists of the smaller number,
always shews the negative or resinous. Its specific gravity is
about 3.

Analysis of Tourmaline from Karingsbrakka in Sweden, by Gmelin, silex 42.59, alumine 34.32, magnesia 8.47, potash and soda 2.42, boracic acid 0.60, oxide of iron 5.22. Berzelius ranks this and other black tourmalines, amongst which he mentions that of Bovey in Devonshire, as potassa-tourmalines. But he found in the blue and green tourmalines of Utö, a proportion of lithia, which has not been given: and he considers the clear blue and the dark blue (Indicolite) as mixtures of potassa and lithia tourmalines: hence it may become needful to separate these from the black tourmalines. Before the blow-pipe the black tourmaline of Bovey intumesces and becomes a black scoriaceous mass; with borax it fuses into a transparent glass. Alone, the green and red intumesce but do not fuse; with borax, with difficulty into a transparent colourless glass.

1



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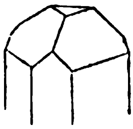

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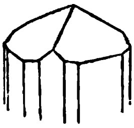
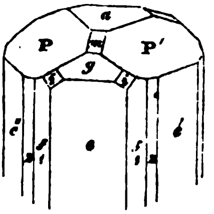


Fig. 1. represents the primary rhomboid, of which the summit is replaced by a triangular plane in fig. 2, as well as each lateral solid angle, by planes which form the ordinary six-sided prism of this mineral; the edges of the prism are modified in fig. 3.



P on P′	133°50′	
P or P′ on *m*	156.50	
P or P′ on *g*	141.10	
P on *i* or P′ on *i*	138. 7	
P or P′ on *e*	117.25	
c on *c′* or *c″*	120.00	
e on *f*1	149.30	
*f*1 on *f*2	155.25	
e on *i* or *i*	147.32	
e on *g*	136.15	
a on *e*	90.00	*cg*
m on *e*	103.30	*cg*

White Tourmaline was found in St. Gothard in micaceous dolomite by Dolomieu, who mentions having discovered a tourmaline in the granite of Elba, one half of which was white, the other black. The emerald *green* are from Ceylon; the dull, or bluish green are from Brazil. In light and translucent green crystals it occurs at St. Gothard. In Massachusets, North America, it occurs with indicolite and rubellite in granite: the rubellite being often inclosed in a bluish green tourmaline. Small tourmalines of various colours and different degrees of transparency are found in the sand of Ceylon. A *yellow* variety was noticed in sand from Ceylon, and in transparent crystals with oxide of titanium, in Pennsylvania. Tourmaline of an indigo-*blue* colour, thence called *Indicolite*, has been found in the mine of Utoe in Sweden, in crystals of an indeterminate form, disseminated in a gangue of steatite, quartz, and felspar. In granite, with green tourmaline and rubellite in Massachusets, North America; and at Harlaem heights, New York. Black or brownish black tourmaline occurs in most of the primitive tracts of Europe and North America, sometimes as an ingredient of rocks, more frequently in veins and cavities. A specimen analysed by Klaproth, yielded 40 alumine, 35 silex, 22 oxide of iron, but neither lime nor manganese. A variety of black tourmaline has been termed the *Aphrizite*; it has a conchoidal fracture: but no information has been given relative to its particular characters and localities.

In England, black tourmaline occurs in the parish of St. Just, in Cornwall, in a tract abounding in iron. The splendid crystals lately found in Devonshire, were accompanied by large crystals of phosphate of lime, and were discovered in a quarry of red granite near Bovey, in a cavity filled by clay.

In Ireland, in the granite of Wicklow.

LEPIDOLITE.*

Lepidolith W. Lepidolite H.

Lepidolite is of a pearl grey, rose red, or of a lilac red or purple colour, whence it has also been called the *Lilalite*. It consists of an assemblage of small flexible scales, which are translucent, and sometimes hexagonal: the mass has a pearly or silvery lustre, yields to the nail, and is somewhat unctuous to the touch. Its specific gravity is 2.85. Analysis of the Red Lepidolite of Moravia by Gmelin and Winz, silex 49.06, alumine 33.61, magnesia 0.408, potash 4.186, lithia 3.502, fluoric acid 3.44, phosphoric acid 0.112, oxide of manganese 1.402, oxide of iron a trace, water and loss 4.190; they likewise found lithia in the lepidolite of Utoe.

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Before the blow-pipe it melts into a spongy semi-translucent white globule.

Crystallized Lepidolite resembles tourmaline, but is much softer, being easily scratched by the knife. It is of a green colour. Analysis by Arfwedson, silex 40.3, alumine 40.5, lithia 4.3, oxide of iron 4.85, oxide of manganese 1.5, boracic acid 1.1, volatile matter 3.6.

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* From the Greek, signifying a scaly stone.

Lepidolite was first discovered in granite on the mountain Gradisko, near Rozena, in Moravia, accompanying the rubellite; it occurred also in a thin bed in gneiss, accompanied by quartz, mica, schorl, &c. with the rubellite also at Perm in Siberia. It has since been met with in Sweden in a quartzose rock; in France, near Limoges, in a vein of quartz, passing through granite, enclosing large beryls; at Campoin, in the island of Elba, of a rose colour, in a rock composed of quartz and felspar.

In Scotland, at Dalmally and other parts of Inverness-shire, in beds of primitive limestone.

PETALITE.*

Petalite Br. Bt.

This rare mineral is of a greyish white, greenish or reddish colour; its structure is perfectly lamellar in one direction, and it admits of mechanical division with some difficulty parallel to the sides and both diagonals of a rectangular but not square prism, apparently with oblique summits. It is translucent, and has a glistening lustre, sometimes approaching to pearly. It is not difficulty frangible; it scratches glass. Its specific gravity is 2.62. According to the analysis of Arfwedson, a Swedish chemist, that of Utoe consists of silex 79.2, alumine 17.2, and 5.7 per cent. of lithia. But Dr. Clarke was of opinion from his own analysis, corroborated by that of Mr. Holme of Cambridge, that the petalite consists of silex 80, alumine 15, lithia 1.75, manganese 2.50, water 0.25. Alone on charcoal, before the blow-pipe, it fuses on the edge with difficulty into a blebby, semi-transparent glass; with borax into a diaphanous glass.

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SPODUMENE.†

Spodumene, D'Andrada. Triphane H.

This mineral occurs massive; its structure is lamellar, being mechanically divisible parallel to the sides and the shorter diagonal of a rhombic prism of about 100° and 80°; its lustre is shining and slightly pearly; it also occurs of a somewhat fibrous structure and silky lustre; the cross fracture is fine grained and uneven, with a glimmering lustre; its colour is greyish or greenish white or light green: it is translucent, scratches glass, and is brittle. Sp. grav. 3.192. Analysis of that

KII
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[*] Petalite, from the Greek, signifying of perfectly lamellar structure (in one direction).

[†] From the Greek, in allusion to its supposed conversion into ashes under the blow-pipe.

of Utoe by Arfwedson, silex 66.4, alumine 25.3, lithia 8.85, oxide of iron 1.45, volatile matter 0.45. Alone before the blow-pipe on charcoal, it intumesces, and fuses into a colourless and almost transparent glass; with borax intumesces, but does not fuse easily.

It has been found in the iron mine of Utoe, in Sweden, in a gangue of red felspar, fat quartz, and black mica; and lately in the Tyrol, on the road to Sterzing, in a granite rock with tourmaline, sometimes crystallized, but the form is indistinct.

In Ireland, in granite veins in granite with killinite at Killiney, near Dublin.

MEIONITE.*

Meionite W. H.

E. XVI
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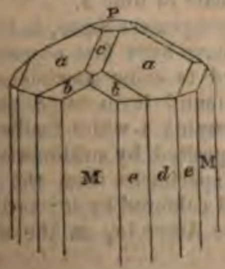
It usually occurs in small four or eight-sided prisms, terminated by tetrahedral pyramids, the edges and angles of which are sometimes replaced; the primary form is a right prism with square bases, and it yields to mechanical division parallel to the planes M M of the following figure; in other directions the fracture is flat conchoidal. Its colour is whitish, or greyish white, with a shining vitreous lustre, and it is translucent or transparent. It scratches glass. Its specific gravity is 2.6—3.1. Analysis of crystals from Vesuvius, but slightly intermixed with carbonate of lime, by M. Gmelin, silex 40.8, alumine 30.6, lime 22.1, soda and lithia 02.4, oxide of iron 01.0, carbonic acid and loss 03.1. Analysis by Stromeyer, silex 40.531, alumine 32.726, lime 24.245, potash with natron 1.812, oxide of iron 0.182. Alone before the blow-pipe it intumesces, and finally melts into a blebby colourless glass.



M on M or P on M or M	90°.00′
M on *d*	135. 2
——— *e*	153.24
d on *e*	161.35
a on *d*	122. 5
M on *a*	112. 5
a on *a*	136.22 H
M on *b*	140.18
a on *b*	151.31

It occurs in the same places and under the same circumstances as the Sommite.

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* From the Greek, signifying, Less; in allusion to the pyramid of its crystal being less or lower than that of Idocrase.

ACIDS.

Of the Acids enumerated in the Introduction, only two have been found in the concrete state, viz. the Sulphuric and Boracic Acids.

NATIVE SULPHURIC ACID.

This acid has been found in a concrete state in the grottoes of the volcanic mountain Zaccolino, near Sienna. The concretions are in the form of cauliflowers, depending from the roofs of the grottoes, and adhering to sulphate of lime. Professor Pictet mentions a cavern near Aix in Savoy, from the roof of which, this acid, mixed with water and a little sulphate of lime, is observed to drop. It has also been seen by Dolomieu in the caverns of Etna. In New York, North America, at Clifton Springs, eleven miles from Geneva, this acid is mixed with native sulphur, from which it may be extracted by water.

NATIVE BORACIC ACID. SASSOLIN.

It is composed of minute white pearly scales, which adhere somewhat to the fingers. It occurs both massive and pulverulent. It is slightly bitter and subacid to the taste, very light, and fusible in the flame of a candle into a vitreous globule. According to Klaproth, it consists of boracic acid 86, ferruginous sulphate of magnesia 11, sulphate of lime 3.

It is found on the edges of hot springs near Sasso, in the territory of Florence; but is said to have been first observed by the late Smithson Tennant, attached to some specimens from Lipari. Dr. Holland afterwards found it in large quantity within the crater of the volcano, forming a white feathery covering to the sulphur, which is deposited by sublimation. It has also been found on volcanic specimens from the Lipari islands accompanied by sulphur, and covered by it; and under the same circumstances near Monte Rotondo, on the west of Sienna.

ACIDIFEROUS EARTHY MINERALS.

Under this head are comprehended those Minerals which chiefly consist of an Earth combined with an Acid; some of them include variable proportions of oxide of iron, which may be considered only as an incidental ingredient.

SUBSULPHATE OF ALUMINE.

Aluminite J.

It occurs massive; sometimes in small and nearly round or reniform pieces, of a white or yellowish white colour, occasionally translucent, but more frequently dull and opaque, with an earthy fracture; it yields to the nail, is meagre to the touch, adheres to the tongue, is light, and infusible. That of Halle and that of Newhaven have lately been examined by Stromeyer, who found that of Newhaven to consist of about 30 of alumine, 23 of sulphuric acid, and 47 of water: that of Halle is nearly the same.

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(1

It was first found, with selenite in calcareous loam, near Halle in Saxony. (*Aluminite.*)

It has since been discovered filling up fissures in chalk and in small globular masses, at Newhaven in Sussex.

Siliciferous subsulphate of Alumine. This singular mineral was lately found in the old workings of a coal mine near Oldham in Lancashire. It formed a thin bed lying on a brittle shivery stone which had fallen into the place formerly occupied by the coal. It is of the consistency of hog's lard, and between snow and milk-white, except where it is streaked with peroxide of iron. It is moderately translucent, except in patches, where it is opaque and granular. On exposure to the air it dries, and in drying splits into lengthened masses like starch, some of which effloresce on the surface, while others resemble in translucency the finest pieces of gum arabic.

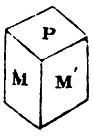
Its composition, according to Dr. Henry, is water 88.1, alumine 6.5, sulphuric acid 3.0, silica 2.4.

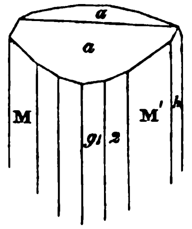
WAVELLITE.* SUB-PHOSPHATE OF ALUMINE.

Wavellit, Klaproth. Hydrargillite, Davy.

It is commonly found in minute crystals, which are rarely
XXXIV. separate, but usually adhere together and radiate, forming
(170) hemispherical or globular concretions from a very small size to
that of an inch in diameter. The general form of the crystals is
CLII. that of a rhombic prism with diedral terminations, but the
(171) lateral edges of the prism are sometimes replaced. It cleaves
parallel to both sides of a prism of 122° 15′ and 57° 45′ by the
CXXXIII. reflective goniometer, and to its longer diagonal, with brilliant
(172) surfaces. The crystals are commonly translucent, sometimes
opaque, and possess a silky or vitreous lustre, but are sometimes
CXXXIV. of a dingy brown, owing to the progress of decomposition. The
(173) wavellite is of a yellowish white, yellow, greyish, greenish or
bluish colour, is brittle, and scratches calcareous spar. Its
specific gravity varies from 2.22 to 2.7. It is infusible, but be-
XLIII. comes white, opaque, and under the blow-pipe loses its crystal-
(174) line form, giving a slight greenish tinge to the flame. According to Aikin, if a fragment of the English or Irish wavellite be laid on glass, and a drop of the sulphuric acid added, it slightly corrodes the glass on the application of heat, rendering it probable that this substance includes a very small portion of fluate of lime. By the late analysis of Berzelius, it is found to be a sub-phosphate of alumine, mixed with a little neutral fluate of alumine; consisting of alumine 35.35, phosphoric acid 33.40, fluoric acid 2.06, lime 0.50, oxides of iron and manganese 1.25, water 26.90.

Primary.





M on M′	122°15′	
a on a	107.26	
a on g2	122.24	
g1 on g2	174.45	?
g1 on h	112.30	?
g2 on h	112.25	

It was first discovered by Dr. Wavel in small veins and in cavities in a tender argillaceous schistus, near Barnstaple, in Devonshire; it has been since found at Stenna Gwyn, near St. Austle in Cornwall, on a decomposing granite: on a specimen in my possession from the latter place, of which the gangue is quartz, the wavellite is accompanied by small crystals of uranite of a bright yellow colour. It has also been found in grey sandstone at Newcastle; at Spring hill near Cork in Ireland, at the base of a hill consisting of flinty slate; and in the crevices of a bed composed of a peculiar siliceous schist at Talisker, in the Isle of Sky. In Corrilevan, one of the Hebrides, in clay-slate. In slate-clay near Loch Humphrey in Dunbartonshire.

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* Wavellite, in honor of Dr. Wavel, its discoverer.

It occurs in grit at Iditz in Bohemia; in columnar clay-
iron-stone in the Palatinate; on white marble in Vesuvius. III (175)
It was brought from Brazil by Mawe in the form of stalac-
tites; and by Humboldt from the mines of Hualgayoe in South DXXXVII
America. (176)

CARBONATE OF LIME.

The numerous minerals comprehended under the term Car- II. (177)
bonate of Lime, differ greatly in external characters. Scarcely
more can be said of them in the general, than that they all XX. (178)
readily yield to the knife, and that their specific gravity is
below 3. CCCCXVIII.

1. CALCAREOUS SPAR.

(179)

Kalkspath W. Chaux Carbonatée H. Spath Calcaire Br. Calc spar J. CCCCXIX. (180)

Calcareous Spar is often extremely pure carbonate of lime,
is frequently very transparent, and is then strongly double CCCCXX
refractive. Its colours are very various, and it is found crystal- (181)
lized in upwards of 500 varieties of form, all originating from
an obtuse rhomboid of 105° 5′ and 74° 55′; this rhomboid may CCCCXXXVI.
readily be obtained by cleavage, and may itself occasionally (182)
be cleaved parallel to a plane passing through the greater
diagonals in one direction, but in this case a substance may CCCCXXXVII
frequently be observed between the laminæ; this cleavage is (183)
often indicated by striæ, and is sometimes attainable, especially XXXIII
in calcareous spar accompanying pargasite from Norway, and (184)
other northern countries of Europe, without any appearance of XXXIV
an intervening substance: the brilliant surfaces of the primary
rhomboid are well adapted to the use of the reflective gonio- (185)
meter: its cross fracture is occasionally conchoidal, but is not XXXV
easily obtained. It is extremely subject to that species of (186)
crystallization which is known by the term macle, or, accord- XXXVI
ing to Haüy, hemitrope. Calcareous spar is not so hard as
fluor spar: its specific gravity is 2.7: it consists of 57 per (187)
cent. of lime, and 43 of carbonic acid. Vauquelin. It effer-
vesces violently with acids. That of Iceland, which is con-
sidered to be the purest form of carbonate of lime, is trans-
parent, and doubly refractive in a high degree. It is familiarly
termed *Iceland spar*, or *Double refracting spar*. Some varieties
of calcareous spar, give a yellow phosphorescent light when

CCCXIV.(188)

CCLXXXV.(189)

CCLXXXVI

(190)

laid on a hot coal ; as that accompanying the laumonite from Britanny, &c. When pure and alone on charcoal, before the blow-pipe, it becomes caustic by heat, and shines with peculiar brightness as soon as all the carbonic acid is expelled.

CCCXVII

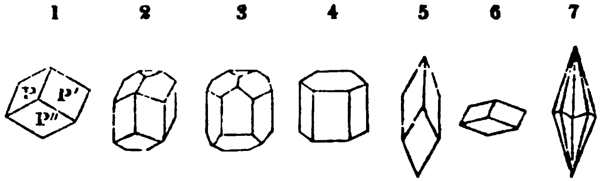
(191)

CCCCXLII(192)

CCCXVI(193)

CCCXVI (194)

CCCCL(195)



CCCLVIII

(196)

CCCCXLI

(197)

Fig. 1. The primary ; an obtuse rhomboid ; Fig. 2. the same, of which the lateral edges, and terminal solid angles are replaced by planes ; Fig. 3, in this both the lateral and terminal solid angles are replaced : both this and the former figure tend, by the extension of the modifying planes, to the production of the six-sided prism (fig. 4), on which no portion of the primary planes is visible. Fig. 5. an acute rhomboid ; fig. 6. a rhomboid more obtuse than the primary ; fig. 7. an acute dodecahedral crystal.

CLXXVII(198)

CCLXXV(199)

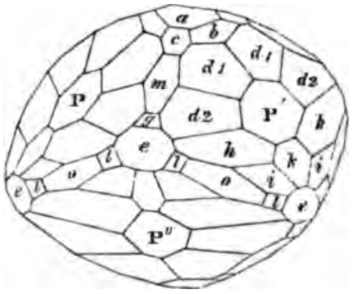
CCLXXV(200)

IV (201)

CLXXV.

(202)

CXLIII(203)



CXLIV

(204)

CCCCXXXV

(205

CCCLXX

(206)

CLIV(207)

CCCLXIX

208

CCCCLVII

(209)

It may be observed that the C. de Bournon has described 56 modifications of the rhomboid of carbonate of lime, and that other mineralogists have greatly increased the number. It would be perhaps impossible to represent the whole of these with any tolerable accuracy on one figure ; the above figure therefore is intended only to point out the fact, that the several modifications are referable to three great classes, viz. prisms, acute rhomboids, and obtuse rhomboids : thus the planes *a* and *e e e*, replacing the solid angles, tend, by their extension, to produce a six-sided prism represented by the small fig. 4 : the plane *a* with the planes *o o o* replacing the lateral edges, likewise tend to produce a regular six-sided prism, while *a* in conjunction with the planes *lllll*, tend to a twelve-sided prism. Thus also of rhomboids, the plane *b* situated on the primary plane, and *c* on the edge, tend to two rhomboids much more obtuse than the primary, or than that which would be consequent on the extension of the planes *m*, while *g* and *k*, would produce very acute rhomboids. The planes *d* 1 *d* 1, of which six are visible on the figure, would produce very obtuse dodecahedrons ; the planes *d*2 *d*2, less obtuse ; while the consequence of the extension of the planes *h h*, would be acute dodecahedrons, and of the planes *i i*, still more acute. But of

homboids both acute and obtuse, there is an almost endless variety, all CCCCXXVII
ctually differing by admeasurement. Thus Bournon alone describes ten (210)
different acute rhomboids as resulting from the different inclination of the CLXXVIII
lane *g*, on the lateral solid angle, and four more from that of the plane *k*;
hus also a great variety of obtuse dodecahedrons would result from the (211)
xtension of the planes *d* 1 and *d* 2, as they may incline more or less upon CCCV
the planes P, or *a*, or on each other. The same observation applies to the (212)
planes *h* and *i*, as tending to the production of a great variety of dodeca- CCCVI (213)
hedrons more or less acute.

It occurs in veins in almost every kind of rock, from the CXXVIII
oldest, to the newest alluvial strata, and accompanies, or con- (214)
stitutes the gangue of, a great variety of minerals; and some- CCCXXII
times it appears in strata, between the beds of calcareous moun- (215)
tains. It is so generally distributed, that it would be impossible XII (216)
to give a list of its localities. The rarest and most beautiful XIII (217)
crystals are found in Derbyshire and the northern parts of Eng- CCCCXXXVIII
land; from which were obtained a very considerable number of
the vast variety described by the Count de Bournon: but it is (218)
so extremely rare in Cornwall, that it is worth noticing as having CXCVIII
been found in veins of the slate of Tintagel, with rock crystal, (219)
chlorite and adularia. I possess specimens also from the tin CCCCXXVI
veins of Polgooth mine near St. Austle, accompanying and pass- (220)
ing into schiefer spar.

2. SCHIEFER SPAR.*

Schiefer-spath W. Chaux carbonatée nacrée H. Slate-spar J.

This mineral occurs massive, and in extremely thin tabular plates intersecting each other in various directions, but without any determinate crystalline form. The structure of the massive is slaty, generally undulating, or curved, with a shining and more or less pearly lustre. Its colour is white, greenish, or reddish; it is translucent, yields easily to the knife, often possessing a greasy feel. Specific gravity about 2.5. It consists of 56 lime, 39.33 carbonic acid, silex 1.66, oxide of iron 1, water 2. Suersee. It is infusible; but is soluble with effervescence in acids.

It occurs in the tin veins of Saxony: in Dauphiné: and in limestone and metalliferous beds in Norway.

In Cornwall it was found in Polgooth mine with tin veins in clay-slate: in Scotland, in Glen Tilt, Perthshire; and Assynt, Sutherland in marble. In Ireland near Granard. In some of the Cornish specimens in my possession, it seems to pass into lamellar carbonate of lime.

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* Schiefer or Slate spar, in allusion to its slaty structure.

3. SATIN-SPAR.*

Chaux carbonatée fibreuse H.

This mineral is composed of fine parallel fibres, which probably are crystalline, and are generally somewhat waved; it is silky, chatoyant, translucent, and brittle, but considerably harder than common calcareous spar. Specific gravity 2.70. C) It consists of lime 50.8, carbonic acid 47.6. Pepys. But a (221) specimen analyzed by the Rev. J. Holme, was found to consist LV of carbonate of lime 95.75, carbonate of manganese 4.25.

(222) It occurs near Alston-moor, in the north of England, in veins from one to four inches thick, accompanied by veins of pyrites, (223) in a brown slaty clay or shale. It is also found in veins in Glen Tilt, Scotland. It is susceptible of a fine polish and is employed in inlaying, and in the manufacture of necklaces in imitation of pearl, but is now very scarce. It is found in Maryland, Pennsylvania, and Massachussetts, in North America.

4. AGARIC MINERAL.† ROCK MILK.

Berg milch W. Chaux carbonatée spongieuse H.

Agaric Mineral is of a white colour, or yellowish or greyish white; and is soft, dull, meagre to the touch, soils the fingers, is very tender, opaque, and so light as to float for a short time on water. It is considered to be nearly pure carbonate of lime, since it effervesces with acids, and is nearly dissolved in them.

It is found in the beds and crevices of calcareous rocks in Switzerland, where it is employed to whiten houses. It is also found near Ratisbon. In England, at Sunderland in the county of Durham: near Oxford between the Isis and the Cherwell, and near Chipping Norton in Oxfordshire. In Scotland, near Edinburgh.

5. APHRITE.‡ EARTH-FOAM.

Schaumerde W. Chaux carbonatée nacrée lamellaire H. Ecume de Terre Br.

This mineral is found sometimes solid, more often in a friable state. It consists of white scales of a shining pearly or a pseudo-metallic lustre. It is opaque, and very soft to the touch. It is nearly a pure carbonate of lime. It is usually found in calcareous rocks in veins or cavities.

It occurs at Gera in Misnia, and more abundantly at Eisleben in Thuringia, in mountains consisting of stratified limestone.

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* From its satiny lustre, especially when polished.

† Described by Pliny under the name of Agaricon;—resembling fungus.

‡ Aphrite, from the Greek;—a foam-like substance.

6. STALACTITIC CARBONATE OF LIME.

Kalk-sinter W. Chaux carbonatée concretionnée H. Calc Sinter J.

Stalactitic carbonate of lime occurs mamillated; in long straight pendulous masses or tubes; also diverging in the manner of coral; and the stalactite is sometimes terminated by a head resembling that of a fungus. The fracture is sometimes perfectly lamellar, sometimes fibrous, the fibres diverging from the center, with a pearly or silky lustre. It is of various colours: the most common of which is yellowish white.

VI (224)

CCLXXXI

(225

Stalactites are sometimes of prodigious dimension, and very numerous; of which the grotto of Antiparos, in the Archipelago; the Woodman's cave, in the Hartz; and that of Auxelle in France, are striking instances.

IX (226)

The most remarkable in Britain, are to be found in the cavern of Castleton, and other caverns in Derbyshire, and Macallister cave in the Isle of Sky. Stalactites occur in all the lead veins of Northumberland and Durham.

Stalactites are now continually forming. They are deposited from water loaded with particles of carbonated lime, in the hollow places and caverns of mountains: the water, finding its way into these caverns through crevices in the roof, becomes exposed to the air; evaporation ensues, causing the particles of lime to precipitate. The precise mode of their formation does not seem to be understood; some are extremely thin tubes, which has caused the suspicion that, at least some of those which are solid, are filled within; others increase externally, and are covered by crystals, as in the Isle of Sky, where the crystals are very distinct.

Some caverns have been entirely filled with calcareous stalactite, so that it is occasionally obtained in large masses; in this state it is called *Oriental Alabaster*, and is much used in statuary and in the formation of vases: it was greatly employed by the ancients. That which was brought from the mountains of Thebais, situated in Egypt, between the Nile and the Red Sea, from near a village called Alabastron, was much prized: a nearly colossal figure of an Egyptian idol, formed of this alabaster, was in the museum (ci-devant Napoleon) at Paris.

Stalactites are not always very pendulous; sometimes they are of a botryoidal form. The flat or tabular portions formed on the floors of caverns, by deposition from the water dropping from the roof, are called *Stalagmites*.

7. GRANULAR LIMESTONE. PRIMITIVE LIMESTONE.

Kalkstein W. Chaux carbonatée saccaroïde H.

Granular Limestone is massive, and composed of small grains or minute crystals, which are of a lamellar structure and brilliant lustre; but as these grains intersect each other in every direction, the lustre of the mass is only glimmering. It is of various colours; white, grey, yellowish, bluish grey, reddish, greenish, &c. and is sometimes veined or spotted. Its fracture is commonly splintery, sometimes slaty, in consequence of containing parallel layers of mica. It is somewhat translucent and is brittle. Of *Primitive Limestone*, which is generally granular, the largest grained is generally esteemed to be of the oldest formation. It never encloses the remains of organized bodies, but frequently contains certain other substances dispersed through the mass; as quartz, garnet, mica, hornblende, talc, actynolite, asbestus, sulphuret of zinc and of lead, magnetic iron, &c.

Granular limestone is found in many, if not most primitive countries; it sometimes forms entire mountains, but more often occurs in beds. It is considered to be of contemporaneous formation with gneiss, porphyry, argillaceous and micaceous schistus, with which it frequently alternates. In the Alps, and especially the Pyrennees, examples of this are of frequent occurrence.

In Britain, primitive limestone occurs in beds in quartz rock
CCXCVIII in Glen Tilt, in Scotland; it is white and grey and spotted with
(227) yellow and green. In the Isle of Sky, it underlies sienite, and occurs white, grey and veined. In Ireland, it alternates with mica-slate in Antrim and Londonderry, and sometimes is micaceous. In Slieve Gallion in the North of Ireland, it contains hornblende. The beautiful marble of the isle of Tiree con-
XXIX tains augite. On the southern coast of Cornwall a limestone
(228) lies on the schist of that county in several places.

The whitest and most esteemed *primitive limestone*, was termed by the French mineralogists Chaux carbonatée saccharoïde, from its likeness to sugar when in small masses: from its important uses in the arts, it is commonly called *Statuary marble*.

Statuary Marble. The most celebrated statuary marble was
CCXCVII found in the island of Paros, thence termed *Parian marble;*
(229) the marbles of Naxos and Tenos, were also called by the same name, being both almost equally valuable for the purposes of the statuary; the quarries of those islands are said to be quite exhausted. Parian marble is white, large

grained and considerably translucent; it was called by the ancients *Lichnites*. The celebrated statues of the Venus de Medicis, of the Venus Capitolini, of the Pallas de Velletri, and many others, are of this marble. The statuary marble called by the ancients *Marmor Pentilicus*, was taken from quarries on a mountain called Pentelicus, near Athens: it is traversed by greenish or greyish veins, which are commonly micaceous. Of this marble, the head of Alexander, the Indian Bacchus, the statue of Esculapius, the head of Hippocrates, &c. were made. The marble of *Carrara* or of *Luni*, is of a much finer grain, and closer texture, than the foregoing; and is now usually employed by statuaries: the quarries of this marble are on the eastern coast of the gulf of Genoa. Among many other celebrated statues made of this marble, are the Antinous of the Capitol; a colossal bust of Jupiter, &c.: and Dolomieu is of opinion that the Apollo Belvidere is of Carrara marble, but the marble-merchants of Rome consider it to be of an ancient Greek marble, differing from any now known. Dr. Clarke remarks, that the Carrara marble is milk white, and less crystalline than the Naxian; and further, that while the works executed in the Parian marble retain, with all the delicate softness of wax, the mild lustre of their original polish, those which were finished in the Pentelican marble have been decomposed, and sometimes exhibit a surface as earthy and as rude as common limestone, owing to the veins of extraneous substances which intersect the Pentelic quarries. Statuary marble was anciently brought also from many other places besides those above mentioned: it is now found in Saxony, Bohemia, Norway, Sweden, &c.

8. COMMON LIMESTONE. SECONDARY LIMESTONE.

Gemeiner Dichter Kalkstein W. Chaux carbonatée compacte H.
Compact limestone J.

Common limestone is sometimes granular, sometimes compact, with a large flat conchoidal and somewhat splintery fracture; but occasionally it is earthy; it is dull internally, or only glimmering: and it is difficult to distinguish some varieties from primitive marbles, their structure being very similar. Its colours are various: yellowish-white, grey, brown, reddish, or bluish, of different shades, and black. Two or more of these colours often occur in veins, zones, bands, &c.: it frequently exhibits appearances of arborizations. It is translucent on the edges, and brittle. Its specific gravity is 2.6. Common limestone sometimes contains small and variable proportions of silex, alumine, and of the oxide of iron. It effervesces with acids, and burns to quick lime without falling to pieces.

Common or secondary limestone is by some geologists divided into two kinds, transition and flœtz; they are characterised by the fossils they contain. Both these rocks are found in thick beds parallel with each other, though rarely horizontal; more frequently, nearly vertical. They are found together, forming a chain of stratified mountains, in the Pyrennees, above 10,000 feet in height. The summits of these mountains are rarely pointed, being mostly flat and of considerable breadth, with very steep sides, to a prodigious height. These appearances are remarkable on the edge of the Alpine, and in the centre of the chain, especially near Grenoble. Secondary limestone encloses beds or masses of red oxide of iron, of sulphuret of mercury, sulphuret and molybdate of lead, manganese, oxide and sulphuret of zinc, &c. These metals are also found in veins passing through these rocks, together with lamellar carbonate of lime, iron pyrites, malachite copper, &c.

In England, Scotland, Wales and Ireland, it is associated with the coal formations, which it underlies forming hollows or basins in which they are deposited. There is reason for concluding it to belong to the earlier secondary rocks: in Derbyshire and the north of England, many rich lead veins traverse it.

Several varieties of common limestone are susceptible of a fine polish; these therefore are highly esteemed as marbles, either for their colours, or for the sake of the various forms and tints of the organic remains they enclose.

Secondary Marbles. Of these there is an almost endless variety. Those most esteemed for ornamental purposes, as for chimney pieces, &c. are brought from Spain, and the Pyrennees, and from Italy. Many marbles consist almost entirely of shells; it is to be regretted that no precise account is to be found of the many beautiful varieties abounding in almost every country. Those of our own country are scarcely noticed beyond the limits of the districts in which they occur, although many varieties are admirably adapted to ornamental purposes.

In Derbyshire there are two quarries of marble of a deep uniform black colour and without shells: one of them is situated at Hadden, the other at Ashford, and both are near Bakewell; the former belongs to the Duke of Rutland, the latter to the Duke of Devonshire; both the marbles are largely employed for the purposes of chimney pieces and ornaments, of which the manufacture is carried on by

Brown & Co. at Derby; who have fixed up in their warerooms a large slab to be used as a looking-glass; of so high a polish are those marbles susceptible.

Near the Peak in Derbyshire, a marble is quarried, which consists almost entirely of fossil shells, chiefly of entrochi; this marble is used for chimney pieces.

At Wetton, near Ashbourne, in the same county, a beautiful variety of marble is quarried, which is of a greyish black colour, and contains a vast number of very minute shells of a whitish colour, giving to the mass very much the appearance of porphyry. This is used for the same purposes as the black marbles above mentioned.

Near Kendall in Westmoreland some varieties of black and grey marbles are quarried; which have some resemblance to varieties of the Derbyshire marbles, and are employed for the same purposes.

At Babbicombe in Torbay, in Devonshire, is quarried one of the most beautiful marbles in existence; its colours vary from light brown to a deep red, and are very finely variegated. This marble is extensively manufactured into chimney pieces in the west of England; an attempt was lately made to introduce this beautiful marble into London; but not being foreign, it failed of success.

In Durham, Buckinghamshire, and other counties of England, other marbles of less note are quarried.

At Kilkenny in Ireland a marble is found of a fine black, enclosing shells of a whitish colour, which, when the marble is cut and polished, exhibit segments of circles. This marble is much used for chimney pieces and ornaments.

Two or three varieties of marble commonly found in mineralogical collections, deserve a slight notice, though somewhat out of place.

The *Verd Antique* consists of carbonate of lime imbedded in green serpentine: its geological situation is not known.

For *Ruin marble*, see Index.

The *Lumachelli marble* exhibits beautiful irridescent colours, which are sometimes prismatic internally, but more commonly of various shades of red or orange, whence it has also obtained the name of *Fire marble*. It is found at Bleyberg in Carinthia in beds forming the roof of a coal-mine. Its colours are attributed to the shells of a variety of nautilus. CCCXXV (2

V(231) The *Cotham marble*, found near Bristol, which exhibits

(232) CCLXXXIX (234)

(233) CCLXC (235)

CCCXXIII (236)

CCCCLXXXI (237)

CCCCLXXXII (238)

XV (239)

CCCXLVI (240)

when cut and polished, the appearance of a landsca
the lias limestone.

CCXLVII Calcareous Shist.

(241) The three following substances may be considered as var
of common Limestone, in which they are occasionally fou

*a. Swinestone.**

La pierre puante Br. Chaux carbonatée fetide Bt. Lucullite J

XXVIII Swinestone, or *Stinkstone*, which gives out a strong fetid
(242) when scraped, is found granular and compact, and of v
shades of grey, brown, and black: it has nearly the
XLVIII external characters as common limestone, of which it is a va
(243) By calcination it becomes white, and burns into quick
The offensive odour which it gives out when scraped, is
LXXXIV sidered to be owing to its including sulphuretted hydr
(244) it is commonly attributed to bitumen, which does not see
enter into the composition of swinestone.

The harder and more compact varieties, which receive a
polish, are used in ornamental architecture.

It is said to occur forming whole mountains; it is more
monly found alternating with strata of gypsum, or of co
limestone. It occurs in Germany, France, and most
countries. It is found in Shropshire and Northumberland
cliffs on each side the Avon at Clifton near Bristol are i
composed of it, and it occurs abundantly in the carboni
limestone of Derbyshire. Botryoidal masses from the siz
pea to two feet in diameter, internally of a hair brown
radiated and shining, are found in a soft, marly, magnesian
stone at Hartlepool, at Building hill near Sunderland, a
the coast near Monk-wearmouth. It is also found in the
of stalactites in the same place.

b. Bituminous Limestone.†

Bituminous limestone is brown or black, which colour
supposed to be owing to the bitumen it contains: its str
is sometimes lamellar; it is more often compact, when it re
a good polish; when rubbed or heated it gives out an unple
bituminous odour; by the continuation of heat, it loses
colour and odour, and burns into quick lime. Analysis o
from Whiteford in Flintshire, by the late Dr. Clarke, Pro
of Mineralogy in the University of Cambridge; lime 49.65
bonic acid 40.10, alumine 8.80, silex 0.60, bitumen 0.60,
0.25.

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* Swinestone or Stinkstone, from the strongly fetid odour it giv
when scraped.

† From its containing a very small portion of bitumen.

Some beds of it are found in the mountain limestone near Bristol.

It belongs to secondary countries, and is sometimes found in coal formations, as in Galway in Ireland, where it is employed as a combustible. In Dalmatia it is so bituminous that it may be cut like soap, and is employed in the construction of houses; when finished, they set fire to the walls; the bitumen burns out, and the stone becomes white; the roof is then put on, and the house afterwards completed.

c. *Argillo-Ferruginous Limestone.*

Argillo-ferruginous Limestone is found massive in beds, and in globular and spheroidal masses, traversed by veins of calcareous spar. It is tougher than common limestone, and is of a bluish black, or greyish blue colour; it has an argillaceous odour when breathed on, and when burnt is of a buff colour. *Calp* is composed of 68 per cent. of carbonate of lime, 18 of silex, 7.5 of alumine, 2 of oxide of iron, 3 of carbon and bitumen, and 5 of water. Knox.

One variety occurs in beds at Aberthaw in Glamorganshire, whence it has obtained the familiar name of *Aberthaw Limestone.* The *Lias* limestone is also argillo-ferruginous. The blue and white varieties alternate with each other, generally, in thin beds. The Lias encloses ammonites, and great variety of sea shells; and is remarkable for containing the remains of unknown animals at Lyme in Dorsetshire. Its geological situation is under the oolite, as near Bath. It is used in the lithographic art. Aberthaw limestone, when burnt, forms a cement, which has the property of setting very strongly under water, and for this reason was used in constructing the Eddystone light-house. The *Septaria (Ludus Helmontii)* occurring in regular layers in the London clay consist of argillo-ferruginous limestone.

9. OOLITE.[*]

Roogenstein W. Chaux carbonatée globuliforme H. Oolite Br.
Roestone J.

Oolite is always found massive, and in beds. The globular particles are sometimes composed of cencentric lamellæ, and usually adhere by means of a calcareous cement. The roe-stone is very soft when first quarried, but hardens by exposure to the air. Its colour is whitish, yellowish white, or ash grey, de- VIII (245 pending, as it is believed, on the quantity and quality of the argillaceous matter with which it is usually combined. It is a very impure carbonate of lime, and will not burn into quick lime. I have been informed by the Rev. Mr. Holme that potash occasionally enters into the composition of oolite.

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[*] Oolite, or Roestone: so denominated from the resemblance between the little round masses of which it is composed, and the roe of a fish.

The houses of Bath are for the most part built of this variety of common limestone, which occurs in great beds above the mountain lime of England. The Ketton-stone, and the Portland-stone, are varieties of roe-stone. The carboniferous limestone of England often includes beds which are oolitic. It is said to occur in Sweden, Switzerland, Thuringia, and near Alençon in France.

10. PEASTONE. PISOLITE.*

Erbsentein W. Chaux carbonatée concretionnée globuliforme-testacée H.

Pea-stone, or Pisolite, differs considerably from the roe-stone; it is generally white, brownish, or reddish, and is composed of round or spheroidal masses, from the size of a pea to that of a hazel nut, imbedded in a calcareous cement: these masses always consist of concentric lamellæ, in the midst of which is commonly found a grain of sand. It is opaque, soft and brittle.

The waters of Carlsbad in Bohemia issue from beds of the pea-stone; it is also found in the waters of the brooks that supply the baths of St. Philip in Tuscany, which suffer a whirling motion in their course. It also occurs in Hungary, and at Perscheesberg in Silesia.

III (246) Calcareous Pudding Stone

11. CHALK.

Kreide W. Craie H. Chaux carbonatée craieuse. Bt.

/II (247) Chalk is usually white or yellowish white, occasionally greyish; it has an earthy fracture, is meagre to the touch, and adheres to the tongue; it is dull, opaque, soft, light, and always occurs massive. Its spec. grav. is about 2.3. A specimen analysed by Bucholz, yielded lime 56.5, carbonic acid 43, water 0.5; one analysed by Kirwan yielded 2 per cent. of alumine.

It is one of the newest secondary rocks, and wherever found is always the prevailing substance, forming hills of three to six hundred feet in elevation, which are remarkable for the smooth regularity of their outline. Chalk is far less abundant in nature than common limestone. The countries in which it is principally found, are Poland, France, and England; (the te limestone of Ireland is identical in geological position) t abundantly in England, forming long continuous hills, seted by ranges of sandstone, and low tracts of gravel and .

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* Peastone, or Pisolite, from the resemblance of its spherical masses to the pea.

)f Chalk there are at least two beds, the upper and the er; the latter is without flints; the former, whatever may ts elevation, is characterised by containing parallel and horital layers of flints. Chalk likewise contains abundance of remains of marine organic bodies, and of amphibious and l animals. A variety, containing some alumine, underlies lower bed: it is of a grey colour. (*Grey Chalk.*)

The uses of Chalk are numerous: when compact it is used for lding; it furnishes lime for cements and manure; it is emyed in the polishing of metals and of glass; by mechanics, marking material, and as moulds to cast metals in; by chets and starch-makers, to dry precipitates on, for which it peculiarly qualified by the facility with which it absorbs ter. It is the white of distemper painting, and, when washed l purified, forms the substance termed whiting.

12. MARLE.

Mergel W. Argile calcifère, ou Marne H.

Marle occurs massive, and either compact, or with a slaty
icture. Its colour is grey, yellowish grey, or bluish grey, CXLIX
purplish red. It falls to pieces on exposure to the air, and (24
then plastic in water; it is easily fusible into a slag, and
rtially soluble in acids with violent effervescence. CCCCLX

Marle is found in thin layers between the beds of several (24
ks, as the Mountain Limestone, and above and below Chalk
halk-marle) as well as interstratified with the Chalk: hence IV (25
th its appearance and composition vary greatly. A variety
alysed by Kirwan, yielded carbonate of lime 50, silex 12,
mine 32, iron and oxide of manganese 2.

1. *Bituminous marle.*

Bituminöser mergelschiefer W. Bituminous Marle-slate J.

It occurs massive, with a straight or curved slaty structure; opaque, of a greyish or brownish black colour, with a glimmer; or shining lustre, and is soft, and meagre to the touch.

It occurs in beds with the oldest limestone, intermixed with e ores of copper; in Thuringia extensive works are employed the smelting of the copper it contains. It is remarkable that large number of fish, of the same species, is also contained in this substance in regular layers ?; the bodies of which are carbonized, or are converted into coal, and sometimes their scales are plated with copper ore; but every fish is in a contorted position, as though it had undergone a violent death by a sudden irruption or deposition of sulphureous and metallic matter: accompanying the fish, are found petrified plants, which appear to belong to the genus, fucus. Monte Bolca is the next remarkable deposit of ichthyological remains.

It abounds also in the Harzgebirge, and in Magdeburg. It occurs in Saxony, Franconia, Bohemia, Switzerland, &c.

13. MADREPORITE.

Chaux carbonatée Madreporite Bt. Prismatic Lucullite J.

It occurs in large roundish masses, which are composed of
LXXIV prismatic diverging concretions: the fracture is indistinctly la-
(251) mellar, somewhat curved; internally it varies from dull to splendent, is opake, or only translucent on the edges; it is of a greyish black colour, and yields easily to the knife: its specific gravity is about 2.7; according to Klaproth it is composed of 93 of carbonate of lime, 0.3 of carbonate of magnesia, 1.25 of carbonate of iron, 0.5 of carbon, and 4.5 of siliceous sand. When rubbed it emits a strong smell of sulphuretted hydrogen gas.

It occurs in Norway at Stavern in transition rocks: at Gyphytta, in alum-slate: in Greenland: and in Salzburg.

14. TUFA.

Kalk-Tuff, W. Chaux carbonatée concretionnée incrustante H.

Tufa is the most impure, the most irregular, and the most porous of all the varieties of carbonate of lime. It varies in respect of hardness, but is sometimes very soft; it is opake, rough, brittle, and is light, cellular, and often incrusts other substances, as vegetable stems, leaves, &c. The various articles which, being placed in certain springs, or waters, in Derbyshire, become covered by an earthy substance, and which thereby acquire the external appearance of petrifactions, are in fact only incrusted by a kind of tufa. It is sometimes sufficiently massive to be employed as a building stone.

It generally occurs in alluvial land, and is found both in Essex and in Derbyshire: and in many of the calcareous springs of Scotland, and on the Continent of Europe.

It is sometimes used as a building stone; sometimes as a filtering stone.

HYDRO-CARBONATE OF LIME.

Da Costa.

This mineral is described as being of a greenish grey colour, transparent on the edges, semi-hard, with a splintery fracture, and glimmering lustre; it is easily frangible; specific gravity, 2.580. Analysis by Dr. Da Costa, lime 47, carbonic acid 36, water 12, silex 3, alumine 2. (Inst. Journ. v. 4, p. 162.)

It occurs in contact with the Basalt of the Giant's Causeway in Ireland. The limestone a few feet from the basalt yielded nearly the same proportions—but it is without lustre, and is traversed by thin veins of calcareous spar.

Analysis of a *Blue Limestone* (*Blue Lava*) *of Vesuvius* (occurring among the ejected matter in masses having the appearance of having suffered by attrition) by Klaproth, lime 58, carbonic acid 28.50, ammoniacal water 11, magnesia 0.50, oxide of iron 0.28, charcoal 0.25, silex 1.25.

ARRAGONITE.*

Arragon W. Arragonite H.

This mineral occurs massive, the texture being generally fibrous, with a silky lustre; in the form of small branches consisting E. LXXVI 6 of fibrous crystals which diverge from a centre, and of which the apices generally appear externally, (*Flos Ferri*); also in crystals which at first sight appear to be regular six-sided prisms, but a close inspection will discover a longitudinal crevice CXLVII (252 down each lateral face, and somewhat similar appearances converging in the centre of the terminal planes. It also occurs in prismatic crystals of four or six sides, terminated by planes, CCLXXXII (253 the prisms often being so short as to impart to the crystal the general form of an octohedron: these are rarely separate, but mostly cross each other at particular angles. It yields to mechanical division parallel to the lateral planes of a right rhombic prism of 116°. 5′ and 63° 55′ by measurements taken with the reflective goniometer on cleavage planes. The crystals are internally shining or vitreous; they are translucent (the small crystals are sometimes colourless and transparent); yield to the knife and are brittle, but scratch calcareous spar easily; sometimes glass, but with difficulty. They refract doubly in particular directions: specific gravity 2.9. By the analysis of the Rev. J. Holme and some other chemists, it appears to consist only of lime, carbonic acid and water; but Stromeyer found in that of Arragon, carbonate of lime 94.5, carbonate of strontian 3.9, hydrate of iron 0.7, water of crystallization 0.3. Bucholz and Meissner have since found strontian in seven of twelve specimens analysed by them. In general the purest, most transparent, and most regularly crystallized, contain the greatest quantity of strontian. The Rev. J. Holme found the specimens crystallized in (apparently) six-sided prisms lose all their transparency by exposure to heat, giving out water; and reduceable to a white opaque powder without decrepitation.

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* Arragonite, from its having been first found in the province of Arragon in Spain.

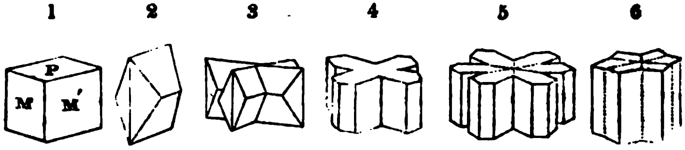
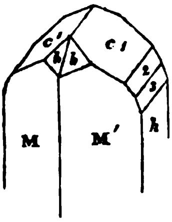


Fig. 1. The primary form, a right rhombic prism, which in fig. 2 is modified by planes replacing the four acute angles, so as to cause the plane P of fig. 1 to disappear. In fig. 3, two crystals of the same form as fig. 2, cross each other. Fig. 4 represents two crystals crossing each other, of which the planes M M and P of fig. 1 appear, but the acute edges of that figure are replaced by planes parallel to the axis of the prism. In fig. 5, three similar crystals cross each other; these do not often occur so distinctly characterized, but more commonly in the form of fig. 6, in which they are more closely united in a crystal, in the general form of a six-sided prism. The dotted lines represent the cracks observable down each plane, arising from the contact of the planes forming the diedral terminations of the several crystals of which fig. 5 is composed; and from the same cause the six lateral planes of this apparently six-sided crystal are not flat; but each presents a slightly re-entering angle.



M on M'	116°30'
M' on h	121.38
M on c 1' or M' on c 1	... 108.18
M on b or M' on b	... 144.00
c 1 on c 1'	108.18
———c 2	150.30
———c 3	141.00
———h	125.55
———b	136.30
b on b	129.33

Crystallized arragonite is found in Arragon, in Spain, disseminated in a ferruginous clay, accompanied by sulphate of lime: at Leogang, in Salzburg, in an argillaceous or a quartzose rock, accompanied by calcareous spar, yellow copper, and arsenical pyrites. The greenish varieties are brought from Marienberg in

Saxony, and Sterzing in the Tyrol. It is also met with at Bastan and Caupenne, in the lower Pyrennees. In Chimboraço, one of the andes of Quito, at the height of 17,000 feet above the sea.

The finest specimens of the branching variety (*Flos Ferri*) are brought from the mines of Eisen-ertz in Stiria: it occurs also at Schemnitz, at St. Marie aux Mines, and in the mines of Baygorri and Vicdessos in the Pyrennees.

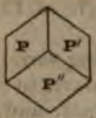
In England, beautiful specimens have been found in the Dufton lead mines, of a sattin-like lustre, and sometimes in acicular crystals: also in a cavern in the greywacké of the Quantock hills, near Merridge, Somersetshire, and at Buckfastleigh, and near Ilfracombe in Devonshire: at Osmanton Mill, five miles east of Weymouth, on the shore, in the inferior oolite; in the workings of an old coal-mine called Luntonhill-pit about 6 miles south-west of Cockfield in Durham, where it was abundantly found depending from the roof of slate-clay, and accompanied by tubular calcareous stalactites. It also occurs in the trap rocks of Scotland.

BITTERSPAR.

Rautenspath W. Chaux carbonatée magnesifère primitive H. Bitterspath Br. Chaux carbonatée lente, Picrite Bt. Rhomb, or Dolomite Spar, J.

E.CXLIX
62

Bitterspar is usually found in the form of its primary crystal, an obtuse rhomboid, which is so nearly allied to that of the carbonate of lime, that it was considered to be the same, until Dr. Wollaston discovered the difference by means of the reflective goniometer. Its angles are 106° 15′ and 73° 45′; but specimens are occasionally found of 107° 20′ and 72° 40′, also on the planes of cleavage by the reflective goniometer, giving rise to the suspicion that these will be found to differ in their composition. The colour of this mineral is greyish or yellow, with a somewhat pearly lustre; and it is harder than calcareous spar, is semi-transparent, and very brittle. It may readily be cleaved into rhomboids of the same form as the crystals, having a splendent and somewhat pearly lustre. That from the Tyrol consists of 68 carbonate of lime, 25.50 carbonate of magnesia, 2 of alumine, 1 carbonate of iron, 2 of water, &c. Klaproth. But the same analyst found the *Columnar Brown-spar of Mexico* to consist of carbonate of lime 51.50, carbonate of magnesia 32, carbonate of iron 7.50, carbonate of manganese 2, water 5; whence it seems probable that the rhomboid of this substance may differ from that of pure carbonate of lime and carbonate of magnesia, as well as from that of carbonate of lime or carbonate of iron. Before the blow-pipe, bitterspar is not distinguishable from calcareous spar, which see.



P on P′ .... 106° 15′

P or P′ on P″.... 73.45

It is commonly imbedded in chlorite, steatite, or serpentine; and is found in the mountains of the Tyrol and of Salzburg; in that of Taberg in Sweden; in that of Chalance in Dauphiné, with asbestus, talc, and chlorite; in the silver mines of Sala in granular limestone. In North America, both massive and fibrous. A columnar variety, intermixed with asbestus, from Miaska in Siberia, has been termed *Miascite.*

In Scotland, on the borders of Loch Lomond, in chlorite-slate, in a vein in transition rocks near Newton Stewart in Galloway. In the Isle of Man in dolomite; and it is said also in the same rock in the north of England.

The following substances may be considered as varieties of bitterspar.

1. MIEMITE.

Miemite, Klaproth. Chaux carbonatée magnesifère lenticulairre. H.

This substance occurs crystallized in a variety of the rhomboid, but more often massive. Internally it is splendent and pearly; the fracture is foliated and curved. It is of a greenish white or green colour, translucent and brittle. Its spec. grav. is 2.8. It consists of carbonate of lime 53, carbonate of magnesia 42.50, carbonate of iron and manganese 3.

It first occurred in Tuscany at Miemo,* imbedded in gypsum; and since in small masses, with wavellite and arragonite at Kanniok, in Greenland.

2. CONITE.†

Conite, Schumacher.

This mineral is described as being of a fine flesh-red colour, amorphous, and externally coated with iron-ochre. The fracture is sometimes fine-grained, sometimes imperfectly conchoidal. It has no lustre, is opaque, brittle, and scratches glass. Its specific gravity is 3.0. According to Dr. John it consists of carbonate of magnesia 67.5, carbonate of lime 28, carbonate of iron 3.5, water 1, sulphate of lime a trace.

It has only been found in Iceland.

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* Whence Miemite.

† From the Greek, signifying Dust; in allusion to its being covered by iron-ochre.

PEARL SPAR.*

Chaux carbonatée ferro-manganesifère H. Variety of Brown Spar J.

It occurs massive, and in obtuse rhomboids with curvilinear faces, which generally are of a shining pearly lustre; it is translucent, yields to the knife, but is harder than calcareous spar; it is of a whitish, greyish, yellowish, or yellow colour. Its XIX specific gravity is about 2.5. A variety analysed by Heisinger yielded 27.97 of lime, 21.14 of magnesia, 44.6 of carbonic acid, 3.4 of oxide of iron, and 1.5 of oxide of manganese. It is infusible; and is soluble slowly and with very little effervescence CCCCXL in cold muriatic acid.

This mineral is often confounded with brown-spar, which is a carbonate of iron; it is indeed extremely probable that the two minerals actually pass the one into the other. The primary crystal of pearl spar is an obtuse rhomboid; and arguing from analogy, there is reason for presuming, that its angles are like those of the bitterspar 106° 15′ and 73° 45′; but as the fracture is curvilinear, it is impossible to measure them with accuracy.

It occurs in many countries on the continent of Europe.

It is found abundantly in the lead mines of the north of England both massive and crystallized; in those of Derbyshire; in that of Beeralston in Devonshire; and in Polgooth tin mine, and several copper mines in Cornwall.

DOLOMITE.†

Dolomit W.

Dolomite mostly occurs massive, and is sometimes of a slaty texture; it consists of fine crystalline grains, which are lamellar; the mass is generally white, occasionally with a tinge of yellow or grey; it is soft, yields to the nail, is translucent on the edges, and when struck, mostly emits a phosphorescent light, which is visible in the dark. It greatly resembles primitive limestone, but is much softer. That of the Apennines consists of 59 carbonate of lime, and 40 carbonate of magnesia: it contains a very variable proportion of iron.

It is commonly found in veins, accompanied by quartz, carbonate and fluate of lime, lead, zinc, iron, silver, &c. It occurs in the Pyrennees, Saxony, France, Sweden, &c.

It occurs in the south-west point of Iona one of the Scottish isles, between vertical walls of that variety of the trap which is termed hornblende rock. It is about 40 feet wide.

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* From its pearly lustre.

† Dolomite, in honour of Dolomieu.

1. GURHOFIAN. COMPACT DOLOMITE.

It is of a snow-white colour, and very compact; the surface, when newly broken, is scarcely shining, and the fragments which are sharp, are translucent on the edges; the fracture is flat-conchoidal, and it is considerably hard: when pounded, and treated with dilute and heated nitrous acid, it completely dissolves with effervescence. Analysis by Klaproth, carbonate of lime, 70.50, carbonate of magnesia 29.50.

It occurs in veins traversing serpentine between Gurhoff* and Aggsbach in Lower Austria.

MAGNESIAN LIMESTONE.

Magnesian Limestone is commonly of a sandy texture, with
CXLIX a glimmering or glistening lustre, and is generally of a yellowish
62 or buff colour. It consists of about 30 of lime, 21 of magnesia, 47 of carbonic acid, 1 of clay and oxide of iron. Tennant. It dissolves slowly and with little effervescence in nitrous acid.

A great range of hills extending from Nottingham to Sunderland, overlying the coal, are entirely composed of it; it also overlies the coal near Sunderland; it forms beds in the Mendip hills in Somersetshire, and in the mountain limestone near Bristol; it occurs at Ballyshannon in Ireland, and at Houth, near Dublin. The Minster and city walls of York are built
CCII of magnesian limestone. It occurs in the Isle of Man. Some-
(256) times, though rarely, it contains shells, &c.

The lime obtained from it is greatly esteemed for cements, being less subject to decay, owing to its absorbing less carbonic
XVII acid from the atmosphere than the lime of common limestone.
(257) But for agricultural purposes it is less esteemed; when laid on particular soils it tends rather to injure than to improve vegetation, which is wholly destroyed when the quantity is large; this effect is owing to the magnesia it contains. An immense tract of chalk in France is wholly divested of vegetation, owing to its containing about 11 per cent. of magnesia.

Flexible Magnesian Limestone differs from the preceding only in possessing, in the large, a slaty texture; when split
VI into thin pieces it is very flexible: this quality seems to
(258) depend on the water it contains; when dry it is nearly lost.

It occurs in horizontal beds in the Marsden rock near Sunderland.

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*Whence Gurhofian.

APATITE.* PHOSPHATE OF LIME.

Apatit W. Chaux Phosphatée H.

Phosphate of Lime is found massive *(Phosphorite)*, and crystallized in six-sided prisms, terminated by one or more planes *(Apatite)*, or the prism is terminated by a six-sided pyramid, and the lateral edges are sometimes replaced; it yields, though with some difficulty, to mechanical division parallel to all the planes of the regular hexahedral prism, which therefore is considered to be the primary crystal; the cross fracture is more or less conchoidal, with a vitreous lustre. It is translucent, rarely transparent. It is white, yellowish-white, wine-yellow, green, blue or bluish-green, and red. These colours are sometimes intermixed in the same crystal. Its specific gravity is about 3. That of Spain (the *Asparagus-stone)* is composed according to Klaproth of lime 54.28, phosphoric acid 45.72. Before the blow-pipe, alone, the *Moroxite* (of a blue-green colour from Norway) is unalterable; but if very small and thin it fuses on the edge with a very strong heat, into a colourless translucent glass; it is one of the most difficult minerals to fuse.

E. CXXIV 63

E. LVI 64

CCV(259)

DXLIX (260)

CCVI (261)

CCCLXXII (262)

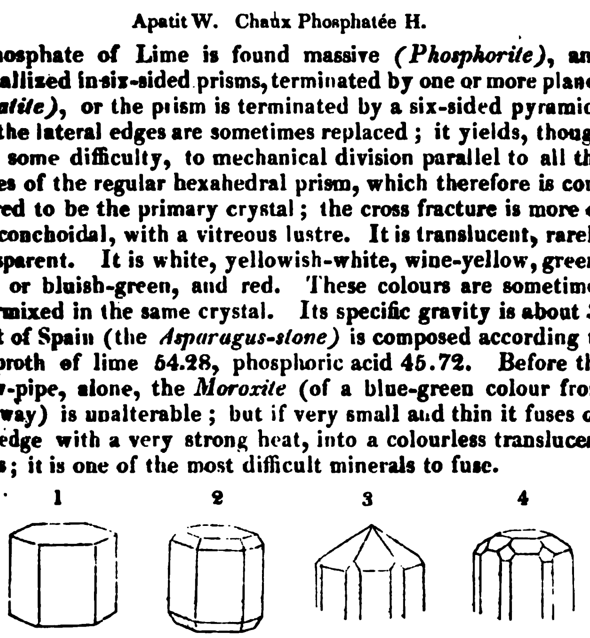
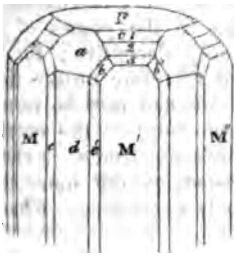


Fig. 1. The primary; a six-sided prism. Fig. 2, the same, of which the terminal edges are replaced; tending to a six-sided pyramid, which is perfect in fig. 3, the lateral edges of the prism being replaced. Fig. 4. In this, the lateral and terminal edges of the prism are all replaced by planes, and its soild angles by small six-sided planes. It occurs in about 30 varieties of form.



M on M' or M' on M''	120.	—
P on M M' or M''	90.	—
M or M' on *d*	150.	—
M on *e* or M' on *e'*	169.	2
P on c1	157.	—
—— *c2*	134.	43
—— *c3*	120.	38
—— *a*	124.	16
M on c1	112.	46
—— *c2*	130.	30
—— *c3*	139.	48
M' on *b* or *b'*	149.	40
b on *a*	162.	18

It is somewhat remarkable that the planes *b b* are rarely seen together on the same crystal.

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* From the Greek, signifying to deceive; in allusion to its being readily mistaken for certain other minerals.

The crystals with pyramidal terminations are said not to be phosphorescent by heat; while those in the form of the primary crystal are so.

It principally occurs in primitive rocks.

In Bohemia and Saxony it occurs in tin veins; in lepidolite in Moravia; in quartz and felspar at Nantes in France; at Arendahl in Norway (*Moroxite*); in transparent crystals, in granular felspar in St. Gothard, and in Spain.

In Cornwall in the tin veins of the granite of St. Michael's Mount, with tin and topazes, &c. with axinite from the cliffs at Botallack near the Land's End, and with tin in Huel Kind, near St. Agness; at Stenna Gwyn in the same county in whitish or yellowish talc; near Bovey Tracey in Devonshire, in large greyish-white translucent prisms, with crystallized tourmaline in a quarry of red granite; with molybdena in granite, near Caldbeck in Cumberland. I possess about thirty varieties in the form of the crystal, which are mostly from Cornwall.

The *phosphorite* is massive, and generally of a granular texture; it is of a yellowish or reddish white colour and nearly opaque; is phosphorescent on the application of heat; it sometimes contains crystals of apatite. It is found at Schlackenwald in Bohemia, but most abundantly near Lagrofan in Estramadura in Spain, in beds alternating with limestone and quartz.

FLUOR.* FLUATE OF LIME.

Fluss W. Chaux fluatée H.

XXVII (263) Fluor is found crystallized, nodular, compact, and earthy;
the former has a perfectly lamellar structure, and may be cleaved
with great ease into the forms of the regular tetrahedron, acute
XXVI rhomboid, and regular octohedron, the latter of which has been
(264) adopted as the form of the primary crystal; occasionally however
the edges of a cube of fluor may be displaced mechanically,
XI (265) affording an apparent cleavage parallel to the planes of the
rhombic dodecahedron, but this is only deceptive; for the
planes so produced are irregular, and therefore unlike those
XXIII parallel to the planes of the octohedron, and may be termed
(266) *planes of composition*. It occurs in the form of the octohedron
and its varieties; as the cube, dodecahedron with rhombic
XXIX planes, &c. Those, in my possession, exhibit more than
(267) 70 varieties of form, which are extremely interesting. Fluor is

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* From the Latin fluo, to flow; in allusion to its important use as a flux to the metallic ores.

found perfectly limpid and transparent; also white, grey, and of various shades of blue, green, red, yellow, and purple, and almost black: when pounded, and thrown on a live coal, it CCCCXI gives out a phosphoric light, blue, green, purple, or yellow; (26 when thrown, in mass, into the fire, it decrepitates and flies. It is harder than calcareous spar; its specific gravity is about 3; CCCCXII and it is composed of 67.75 of lime, and 32.25 of fluoric acid, (26 according to Klaproth: but the colourless and transparent variety of Alstone Moor yielded to Berzelius 72.137 of lime, and 27.863 of fluoric acid. Alone on charcoal before the blowpipe it fuses by much heat into an opaque globule; with borax into a transparent glass.

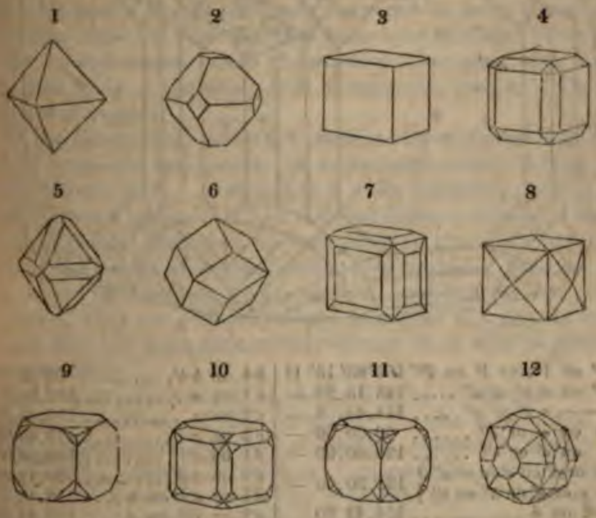
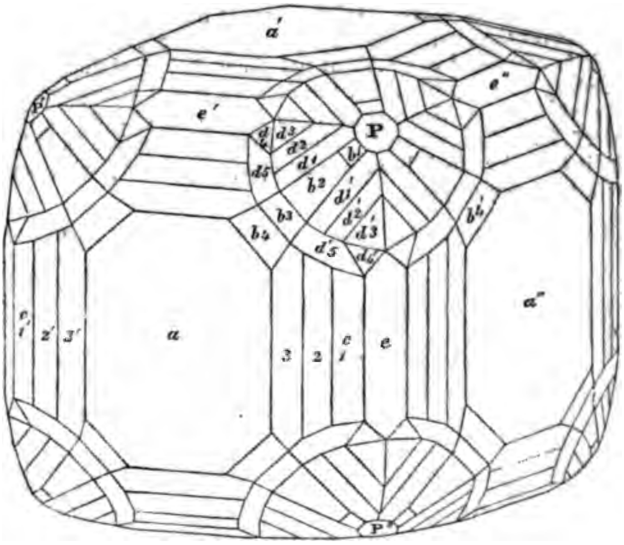


Fig. 1. The primary; the regular octohedron. Fig. 2. the same, having all its solid angles replaced by square planes, which are enlarged and complete in fig. 3. the cube. Fig. 4. the cube of which the edges and angles are replaced. Fig. 5. the octohedron, of which the edges are replaced by six-sided planes; which in fig. 6 are complete and of a rhombic shape; forming the rhombic dodecahedron. Fig. 7. the cube of which each edge is bevilled, or replaced by two planes; these planes are complete in fig. 8, forming a solid bounded by twenty-four triangular planes. Fig. 9. the cube, of which each solid angle is replaced by three planes; which, in fig. 10, are seen in combination with planes replacing the edges of the cube. Fig. 11. the cube, of which each solid angle is replaced by six planes, which are enlarged and nearly complete in fig. 12: representing a crystal bounded by fifty-four planes. I possess about seventy varieties in the form of the crystals of fluor,

One crystal (from Devonshire) in my possession, exhibits all the planes represented on the annexed figure except *b* 1 3 and 4, and c 3. It is not a perfect crystal, but if it were, it would be bounded by 322 planes.



P on P′, or P on P″	109°28′16″ H	*b* 4 on *b* 4′	92°50′00″
P on *a* *a*′ or *a*″	125.15.52 —	c 1 on *a*	147.00.00
— — *e* *e*′ or *e*″	144.44. 8 —	c 2 on *a*	174.40.00
a on *a*′ or *a*″	90.00.00 —	c 3 on *a*	179.40.00
e on *e*′ or *e*″	120.00.00 —	*d* 1 on *d* 1′	166.50.00
a or *a*′ on *e*′, *a* or *a*″ on *e* or *a*′ on *a*″ on *e*″	135.00.00 —	*d* 2 on *d* 2′	160.12.00
b 2 on *a*	154.45.00	*d* 1 or *d* 1 on *a*	153.10.00
b 3 on *a*	156.50.00	*d* 2 or *d* 2 on *a*	155.44.00

The varied colours of Fluor formerly gave rise to the now exploded names of false sapphire, false emerald, false amethyst, false ruby, and false topaz.

Crystallized Fluor is found at Mont Blanc and St. Gothard, on the latter in octohedrons of a rose red colour; in Saxony, Germany, and in many other countries, it occurs in veins in primitive mountains; and accompanies oxide of tin, mica, apatite, and quartz, in the tin veins at Zinnwald in Bohemia.

It is very abundant in the tin and copper veins of Cornwall and the lead veins of the north of England and Derbyshire. It is of various shades of the forementioned colours from each of those districts. Those of the north of England generally possess the greatest transparency. The Beeralstone mines, in Devon, have yielded the rarest and most complex varieties of form. Some crystals from that mine in my possession, would, if perfect, exhibit 322 planes, being 192 more than were observed by Haüy on a crystal of iron pyrites, the most complex crystal he had seen.

The most beautiful varieties of Cornwall have been found in the tin veins of St. Agnes which are in clay-slate, where it is sometimes accompanied by yellow topazes. It is also found with tin, topaz, mica, apatite and quartz in veins in the granite of St. Michael's Mount: it lately occurred in large cubes of a dark blue colour in Huel Gorland mine near St. Day: in several of the tin and copper mines of Cornwall, fluor sometimes forms the great body of the vein; it is occasionally used as a flux for the ores of copper.

In the Beeralstone mines it occurs in clay-slate and is accompanied by galena and quartz. A remarkable variety is found in the neighbourhood. It occurs in a white hornstone, and sometimes between layers of it: on dividing them, crystallized white octohedral fluor is discovered imbedded in greenish fluor, also bearing the marks of crystallization: on breaking the crystals, the surface of which is white, opaque, and in a state of disintegration, they are generally found to consist of a minute octohedron that has been successively coated so as still to produce the same form.

In Durham, fluor occurs in the lead veins which traverse the mountain limestone of that country. In the same veins are found carbonate and sulphate of barytes, calcareous spar, pearl spar, blende, quartz, &c. Fluor of an emerald green, containing drops of water, occurs in the Weardale mines. Some of the varieties of green are superficially of a fine purple colour. In Lancashire, occasionally with hæmatites iron ore.

In Derbyshire, the lead veins also traverse the mountain limestone, and fluor is there accompanied by calcareous spar, cawk, galena, &c.

In the mountain limestone of Bristol, crystals of purple fluor are found with calcareous spar, sulphate of strontian, and oxide of iron, in the cavities of the Black rock.

In Scotland, it is a rare mineral, having only been found in a vein traversing granite in Aberdeenshire; and in Papa Stour, one of the Shetland islands, in a trap rock. In Ireland, in cavities in the granite of the Dalkey coast.

Nodular fluor. In the Odin mine, near Castleton in Der
shire, fluor is found in veins, in detached masses, f
three inches to a foot in thickness; their structure is di
gent, and their colours, as grey, yellow, blue, brown,
generally disposed in concentric bands: of this vari
called *blue john* by the miner, are made beautiful va
obelisks, &c. by Mawe & Co. at Derby. Fluor is no wh
else found adapted to these purposes.

Compact fluor is harder than common fluor, and is sometime
a granular texture; in general, it is translucent only
the edges; when placed on a live coal, it mostly gives
a green light: some specimens in my possession from
nandrae mine in Cornwall, exhibit lights of various sh
of green, blue, violet, and red.

It also occurs in the Hartz, in Norway, &c.

CXXX *Earthy fluor* is of a friable texture, or in the state of a pow
(270) It is found in Saxony and Norway. In England, in
Breckensyke mine, Durham, with partially decomp
galena: in a granular, pulverulent state and white, in
Beeralstone lead mine, Devonshire.

Chlorophane is esteemed to be a variety of fluor; of whic
has not perfectly the aspect, being sometimes of an im
XIII fectly lamellar structure, but it is equally hard, freque
(271) much harder. It is usually of a pale violet colour,
translucent. It does not fly in the fire, but gives o
phosphorescent light of a most beautiful emerald gre
colour; a specimen in my possession, from Pednand
gives out this light when placed in the flame of a ca
or on a live coal; but Pallas mentions a specimen f
Siberia, of a pale violet colour, which gave a white l
merely by the heat of the hand; by the heat of boi
water, a green light; and when placed on a live co
brilliant emerald light, that might be discerned fro
distance.

ANHYDROUS GYPSUM.[†] ANHYDRITE.

Of this mineral there are several varieties. It occurs c
XXIX tallized (*Muriacite*), granular, fibrous and compact; it also
65 curs siliciferous (*Vulpinite*).

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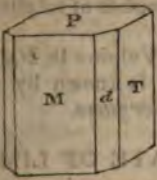
[*] Whence Chlorophane, signifying brilliant green.

[†] Gypse is said to have been the term given by the ancients to cal
sulphate of lime: that mineral in its natural state is now termed gyp
It contains water. Anhydrous (from the Greek) signifies without wate
is the case with Anhydrite; it also received the name of Muriacite,
its occasionally containing some muriate of soda.

Muriacite. Wurfelspath W. Chaux anhydro-sulphatée laminaire H. Cube spar J. The muriacite occurs crystallized in the form of a rectangular prism, of which the lateral edges are sometimes, though rarely, replaced. It readily yields to mechanical cleavage parallel with all the planes of the prism; and more difficultly with its diagonal. It is white, violet, bluish or reddish, is translucent, sometimes transparent, with a splendent, pearly lustre. It possesses double refraction. It scratches calcareous spar. Specific gravity, 2.5. According to Vauquelin it consists of 40 of lime, and 60 of sulphuric acid; but by some analyses it appears to contain 1 per cent. or less of muriate of soda; and it is supposed to be owing to the presence of salt that it becomes glazed over with a white friable enamel before the blow-pipe.



P on M or T	90.° 0′	H
M on T	90. 0	—
M on *d*	140. 4	—
T on *d*	129. 56	—

It is found in the salt mines of Halle in the Tyrol, about 5000 feet above the level of the sea; and in those of Bex in Switzerland.

It is said to have been found in common gypsum in Nottinghamshire.

Granular Anhydrous Gypsum. Chaux sulphatée anhydre lamellaire H. Scaly anhydrite J. This variety is found in massive concretions of which the structure is confusedly foliated. It is white, greyish, or bluish; translucent on the edges, and of a shining pearly lustre. It consists of lime 41.75, sulphuric acid 55, muriate of soda 1. Klaproth.

It occurs in the salt mines of Halle.

Fibrous Anhydrous Gypsum. Fibrous and radiated Anhydrite J. It is found massive, of a greyish, greenish grey, bluish or reddish colour: it is translucent on the edges, and of a shining or pearly lustre. The fibrous occurs at Halle in the Tyrol, and at Ischel in Upper Austria; the radiated occurs in the same places, and also near Brunswick in common gypsum, and in Carinthia.

Compact Anhydrous Gypsum J. This variety occurs massive, contorted, and reniform. The fracture is splintery passing into flat conchoidal: it is translucent, or only translucent on the edges, scratches calcareous spar, and is harder than the preceding varieties. It consists of lime 42, sulphuric acid 56.50, muriate of soda 0.25. Klaproth.

It occurs in the salt mines of Austria and Salzburg; and at the foot of the Hartz mountains: the contorted variety (termed *pierre de trippes*, from its resemblance to the convolutions of the intestines), is only found in clay, in the salt mines of Wielitzka and Bochnia in Poland.

Siliciferous Anhydrous Gypsum. Chaux anhydro-sulphatée quartzifère H. Vulpinite J. It is found in distinct massive concretions of a laminated structure, translucent on the edges, splendent, soft, and brittle; and of a greyish white veined with bluish grey. It consists of sulphate of lime 92, silex 8. Vauquelin.

It occurs with limestone at Vulpino in Italy.

It takes a fine polish, and is known by artists by the name of *Marmo bardiglio di Bergamo.*

LXVII (272)

GYPSUM.* SULPHATE OF LIME.

Gyps W. Chaux sulphatée H.

LXVIII (273) Of Gypsum there are several varieties. It occurs crystallized (*Selenite*), fibrous, of a granular texture, compact, and earthy.

CCXXXIII *Selenite.*† Chaux sulfatée crystallisée H. It occurs generally
(274) in flattish crystals, which are oblique parallelopipeds. The
primary form is considered to be a right oblique angled
prism, of which the bases are oblique-angled parallelo-
grams of 113° 8′ and 66° 52′: it cleaves with ease and
CCCCV (275) brilliancy parallel only with the terminal planes P of the
following figures, but cleavages parallel to the lateral
CCCCXVII planes may be attained with great care, from the finely
(276) divided laminæ: the natural joints are mostly visible.
The lustre is shining, sometimes pearly. It is more or
CCCCVI less transparent, and so soft as to yield to the nail. It is
(277) of various shades of white, yellow, grey, brown, red, and
violet. Reduced to thin laminæ, it is flexible but not
CCCCXXV elastic. Its specific gravity is about 3. It consists of 32.7
(278)

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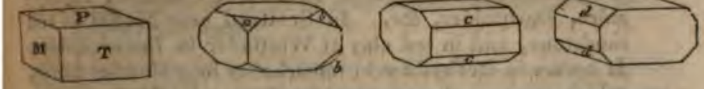
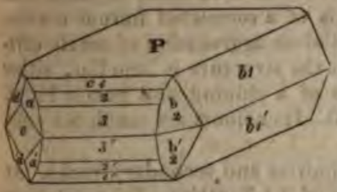
[*] See preceding note.

CCXXXIV (279) [†] Selenite, from the Greek; in allusion to the brilliancy with which it reflects the moon.

of lime, 46.3 of sulphuric acid, and 21 of water. After giving off its water in the matrass, before the blow-pipe in the platina forceps, it fuses with difficulty into a white enamel.



The preceding figures are given only with a view to elucidate the manner in which the modifying planes *a b c d* of the following figure are situated on the angles or edges of the primary.



P on M on T (primary)	90°00′
M on T ....ditto..	113.08
P on *b* 1	108.00
—— b 2	144.40
—— c 1	153.55
—— *c* 2	143.42
—— c 3	124.20
—— *a*	112.14
—— *d*	110.51
—— *e*	90.00
b 1 on *b* 1	143.48
b 2 on b 2	108.05
c 3 on c 3′	111.20
a on *a*′	138.42
a on c 3	118.18
d on *a*	149.20
b 2 on *c* 3	126.00 *cg*

Selenite is most commonly met with disseminated in argillaceous deposites; not often in veins: but it is said to have been met with in a vein of yellow copper ore, traversing a primitive mountain, near Neusol in Hungary: in a lead vein in Bohemia; and in the silver mine of Seinénofske in the middle of the Altaic mountains in Siberia.

In England, it occurs at Alston in Cumberland; and in clays, as in the London clay, in the south of England, and in clay at Shotover hill in Oxfordshire; where in all probability it has arisen from the decomposition of sulphuret of iron; it is manifestly the case in some of the places in which it is found.

Fibrous Gypsum. Chaux sulphatée fibreuse H. It occurs in CCXXX
extremely delicate and nearly separate fibres; also massive, (22
of which the fibres are either straight or curved. It has a
glistening, or pearly lustre, and is of various shades of CCXXXV
white, grey, yellow, and red. It is generally translucent, (28
and is soft.

It occurs pretty abundantly in the newer secondary deposites of gypsum, in France, Switzerland, Bavaria, and other countries of the continent of Europe.

In England it occurs abundantly in the red marle or new red sandstone formation in Yorkshire, Cheshire, Derbyshire, Devonshire, &c. In Scotland near Moffat in red sandstone, and in red clay at Whittader in Berwickshire. It occurs in Derbyshire in remarkably long slender fibres, XXI which are generally associated and curved (*Plumose Gypsum*). (282) At Matlock it occurs also in straight fibres of great brilliancy, laterally aggregated, and of which the cross fracture is lamellar, and of remarkable lustre.

Granular Gypsum. Foliated granular gypsum J. It occurs generally massive; but sometimes encloses crystals in its cavities; occasionally it is of a somewhat fibrous texture. The massive is composed of an aggregation of small crystalline laminæ, of which the structure is lamellar, either straight or curved. It is of a shining and pearly lustre, translucent, and very soft. Its colours are much the same as those of selenite.

It occurs in beds in primitive and secondary rocks. At Luneberg it is the matrix of the boracite. In Ariolo near St. Gothard it occurs in beds in gneiss; in the Valais in hornblende slate. In several countries of Europe and America it occurs in flœtz rocks.

It is found in Cheshire and Derbyshire in beds in marle.

Compact Gypsum. Chaux sulphatée compacte H. It occurs only massive; its fracture is compact, or slightly splintery; it is dull, or possesses a glimmering lustre; is very soft, and CXLIX translucent on the edges. Its colours are much the same as (283) those of selenite, but it is often party-coloured; either spotted or veined.

It occurs in several countries of the continent of Europe and in North America.

In England, at Ferrybridge in Yorkshire, in Nottinghamshire and in Derbyshire. It is a variety of *Alabaster*. It is employed by the architect for columns and other ornaments, being more easily worked than marble; it is also turned by the lathe into cups, basins, vases, and other similar articles. The manufacture of these articles in gypsum is carried on by Brown & Co. of Derby, to a considerable extent. Alabaster is found in the neighbourhood, both white, and with veins of a reddish brown colour. The large columns employed in the building of the elegant mansion called Kedleston Hall, which is in Derbyshire, are of the variegated alabaster of that county.

Earthy Gypsum. Chaux sulfatée terreuse H. It occurs in loose earthy particles or scales, which are dull or possess a glimmering lustre.

It occurs in beds, lying upon, or is found enclosed within, the strata of secondary formations of gypsum, in Saxony, Salzburg, and Norway.

NITRATE OF LIME.

Chaux nitratée H.

It occurs in fibrous efflorescences, often united in the form of silken tufts, or in a pulverulent slate. It is very deliquescent and is soluble in water. On burning coals it melts slowly, with slight detonation, and as it dries, loses its acid; the residue does not afterwards attract moisture from the air, and is phosphorescent. It consists of lime 32, nitric acid 57.44, water 10.56.

It is found in silky efflorescences on old walls, in caverns, or on calcareous rocks, in the neighbourhood of decayed vegetable matter; and in some mineral waters. Its taste is bitter and disagreeable.

DATHOLITE.* BORATE OF LIME.

Datholit W. Chaux boratée silicieuse H. Chaux Datolit Bt.

E. XXI 66

E. CXLII 67

The Datholite is greyish or greenish white and translucent. It occurs massive, and crystallized in rhombic prisms of which the lateral edges and the solid angles are commonly replaced by planes: the fracture is imperfectly conchoidal, with a somewhat vitreous lustre; it yields to the knife. Specific gravity about 3. The primary form is considered to be a right rhombic prism of about 103° 40′, and 76° 20′ from the measurement of its natural planes by the reflective goniometer. According to Vauquelin, it is composed of 34 of lime, 21.67 of boracic acid, 37.66 of silex, and 5.5 of water. When exposed to the flame of a candle it becomes opaque, and may then be easily rubbed down between the fingers. Before the blow-pipe it intumesces into a small white mass, and then melts into a globule of a pale rose colour.

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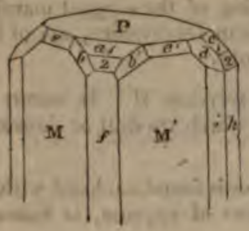
* Datholite, from the Greek, signifying turbid; in allusion to the want of transparency in the mineral.



P on M on M′	90°00′
M on M′	103.40
M or M′ on *f*	141.48
— on *e* or M′ on *e′*	129. 5
M′ on *i*	160.45
P on *a* 1	112.25
—— c 1	147.45
—— *c* 2	128.15
—— *d*	140.00
—— *e* or *e′*	140.55
—— *h* on *i*	147.50
—— *d* on c 1	157.00
—— *f* on *a* 2	141.00 e g

It has been found, with calcareous spar and prehnite, in mica-slate at Arendahl in Norway: also in small veins in greenstone on the Giesalpe near Sonthofen,

1. BOTRYOLITE.

It occurs in mamillary concretions formed of concentric layers, having a splintery or fibrous texture; it is brittle, translucent on the edges, and externally is of a pearl or yellowish grey colour; internally white, greyish, and red in concentric stripes. It also occurs in small botryoidal* masses, which are white and of an earthy texture. Its specific gravity is 2.8. It consists of 39.5 lime, 36 silex, 13.5 boracic acid, 6.5 water, 1 oxide of iron: Klaproth. Before the blow-pipe it melts into a white glass. It is considered to be a variety of the Datholite.

It has been found near Arendahl in Norway in a bed in gneiss, accompanied by schorl, magnetic iron-ore and iron pyrites.

PHARMACOLITE.† ARSENIATE OF LIME.

Arsenicblüthe W. Chaux arseniatée H.

The Pharmacolite is found in minute fibrous, or acicular crystals, which commonly are aggregated into botryoidal or globular masses, of which the lustre is glimmering or silky; but they are sometimes dull. Its proper colour is white or greyish white; but the *surface* is often tinged of a red or violet colour by arseniate of cobalt. Its specific gravity is 2.6, and it consists of 25 per cent of lime, 50.54 of arsenic acid, and 24.46 of water. Klaproth. Before the blow-pipe it is for the most part volatilized, with a dense white arsenical vapour.

.XX
68

The analysis by Stromeyer of a substance, under the name of *Picropharmacolite* has been published, but without either description or locality. It appears however to be closely allied to the pharmacolite, since he found it to consist of lime 24.64, magnesia 3.21, arsenic acid 46.97, water 23.97, oxide of cobalt 0.99. The latter ingredient induces the suspicion that it is tinged of a red colour.

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* Whence Botryolite from the Greek, in allusion to the resemblance in form to grapes.

† Pharmacolite from the Greek, in allusion to its containing poison.

The Pharmacolite occurs at Andreasburg in the Hartz: at Riegelsdorf, and Glucksbrunn in the forest of Thuringia; at Wittichen, near Furstemburg in Germany, disseminated on granite, in a vein containing cobalt, barytes, and sulphate of lime. At St. Marie-aux-Mines, in the Vosges, it is found perfectly white.

CARBONATE OF MAGNESIA.

Four varieties are said to have been discovered, viz. Crystallised, compact, earthy, and pulverulent.

Crystallized Carbonate of Magnesia. It is said to have lately been found at Hoboken in Staten Island, in fine acicular crystals grouped together in a radiating direction; the crystals being sometimes suspended in the form of stalactite. E. LXXV 69 Also in horizontal veins about two inches thick in a serpentine rock; but in this case, the substance is at first soft, white and slightly adhesive, but when dry is easily reduced to powder. It is perfectly soluble with effervescence in sulphuric acid, yielding on evaporation, crystals of sulphate of magnesia.

Compact Carbonate of Magnesia. Magnesite. Reinè oder naturlische talkerde W. Magnesie carbonatée H. This mineral is found amorphous, tuberous and spongiform: the fracture is splintery or large flat conchoidal; it is nearly CXCIX 70 opaque, dull, and yields to the nail externally, but internally is a little harder than calcareous spar; it is somewhat meagre to the touch, and adheres to the tongue. It is of a grey or yellowish colour with spots and dendritic delineations of blackish brown. Its specific gravity is 2.8. That of Stiria consists of 48 of magnesia, 49 of carbonic acid, and 3 of water: Klaproth. That of Baldissero consists according to Berthier of magnesia 44.0, carbonic acid 41.18, silex 9.4, water 0.4. Other varieties do not essentially differ in composition.

It occurs at Gulfen in Upper Stiria in serpentine, with bronzite; at Hrubschiz in Moravia in serpentine with meerschaum, &c.; and in the same rock at Baldissero and Castellamonte in Italy; at Vallecas in Spain; at Baumgarten in Silesia; in serpentine, in the Bare hills near Baltimore, North America.

It is used in porcelain manufactories.

A variety has lately been received from the East Indies by Dr. Babington of a snow white colour. Specific gravity 2.56. It gives sparks with the steel, but does not scratch fluor. It dissolves in acids, at ordinary temperatures, with extreme slowness, even when finely powdered, but by heat its solution is quickened, and carbonic acid is disengaged. Analysis by Dr. Henry, magnesia 46, carbonic acid 51, insoluble matter 1.5, water 0.5, loss 1.0.

Earthy Carbonate of Magnesia. Meerschaum. Meerschaum[*] W. Ecume de Mer Br. Meerschaum is of a whitish or yellowish white colour, opaque and dull; it has an earthy fracture, yields easily to the nail, and adheres strongly to the tongue; sometimes it is so light as to swim on water, and occasionally is very porous. It consists of 45.42 of magnesia, 47 carbonic acid, 4.5 silex, 2 water, 0.5 alumine, with traces of manganese and lime. Tromsdorff.

It occurs in the isles of Samos and Negropont in the Archipelago, in mass, or disseminated, or in beds: at Kiltschik in Natolia; it is soft when first dug, and in that state is made into pipes, but hardens by exposure to air. It is also met with in Carinthia, in Moravia, and in Spain. It is said to occur in veins in the serpentine of Cornwall.

In the Turkish dominions, Meerschaum is employed as fuller's earth is with us; and by the women as soap for washing their hair. In Constantinople it is termed *Keffekill* or earth of Keffa, the town of the Crimea whence it is shipped.

Pulverulent Carbonate of Magnesia. This mineral was brought from India a few years ago, under the name of Native Carbonate of Magnesia. It is in the form of a light powder, or in small roundish friable lumps nearly white or slightly tinged with yellow. It adheres to the tongue, and the fracture is very earthy, resembling that of chalk. Dr. Thomson found it to be composed of carbonate of magnesia 72, carbonate of lime 28.

SULPHATE OF MAGNESIA.

Naturlischer Bittersalz W. Magnesie sulphatée H. Sel d'Epsom natif Br.

It occurs in crystalline fibres, rarely pulverulent; it is white
LXXIV or of a grey colour, and transparent or opaque; it is very brittle,
and its taste is bitter and saline.

(71)

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[*] Meerschaum; Ecume de Mer; in English, Sea-foam.

It is found on the surface of decomposing schistus, or of gypsum, or of the soil, and often in coal pits, also on decomposing lava and sandstone. It has been observed in the quicksilver mines of Idria; on the surface of gypsum in the quarries of Piemont, and of Mont-martre near Paris; on the surface of the soil in many large tracts of Andalusia in Spain, after floods; and in efflorescences on the mortar used in the foundations of houses in Madrid. Similar effects are occasionally to be noticed in this country.

In Scotland it occurs as an efflorescence at Hurlet near Paisley, with natural alum.

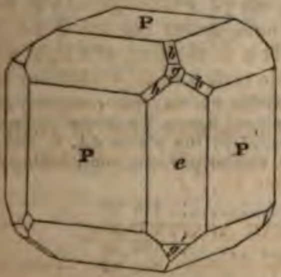
BORACITE. BORATE OF MAGNESIA.

Boracit W. Magnesie Boratée H.

It occurs only crystallized in the general form of the cube, of which the edges are replaced, and the diagonally opposed solid angles dissimilarly modified; the cube is considered by Haüy to be the form of the primary crystal; the fracture is uneven, or imperfectly conchoidal, with a glistening lustre; it is mostly translucent, is hard enough to give sparks with the steel, and is of a yellowish, greyish or greenish white; the opaque white crystals are not so hard, and contain a proportion of carbonate of lime. Its specific gravity is 2.56. It consists according to Vauquelin of 83.4 of boracic* acid, and 16.6 of magnesia. It is fusible without addition on charcoal into an opaque white glass.

8. XIII
72

It is remarkable that the diagonally opposed solid angles, on the application of heat, become, the one positive electric, the other negative.



P on P	90°00′00″ H
—— *g*	125.15.52 ..
P or P on *e*	135.00.00 ..
—— *b*	144.44.08 ..

It has only been found in gypsum in the Kalkberg in the duchy of Brunswick, and at Segeberg near Kiel in Holstein; at the latter place the boracite is sometimes imbedded in anhydrous gypsum.

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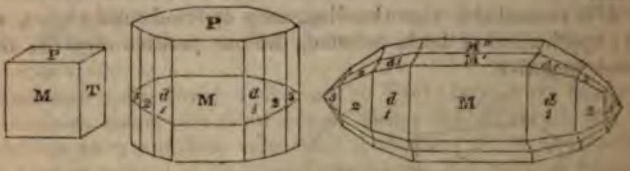
* Whence Boracite.

WITHERITE.* CARBONATE OF BARYTES.+

Witherit W. Baryte carbonatée H.

It occurs massive, stalactitic, and crystallized; the structure
of the massive is fibrous or bladed, and the cells often contain
XXVI small crystals, which in their general form resemble the common
(284) variety of quartz crystals, namely, a six-sided prism terminated
by six-sided pyramids; but by the assistance of the
XXVII reflective goniometer it is found, that the measurements are not
(285) those of a regular six-sided prism, being on the lateral planes
(M on M′) only 118° 30′; hence these crystals may be considered
CCLIII as macles, much resembling the artificial crystals of sulphate
(286) of potash (see Ann. of Phil. Nov. 1822), their primary
form probably being a right rectangular prism. In some crystals
XXIX a re-entering angle is to be observed on the alternate planes
of the prism, as in the following figure, in which case the crystal
(287) is a macle in a double sense. It is translucent internally,
and of a glistening lustre; externally the small crystals are generally shining, the larger are opaque. It is generally whitish, sometimes greyish or greenish white, rarely reddish. Specific gravity 4.3. That of Stiria consists, according to Klaproth, of 78 barytes, and 22 carbonic acid: that of Snailbach in Shropshire, of carbonate of barytes 96.3, carbonate of strontian 1.1, sulphate of barytes 0.9, silex 0.5. Aikin. Before the blowpipe, it melts into a white enamel: it is soluble with effervescence in dilute muriatic or nitric acid.



The first figure represents the probable primary form,—namely, a right rectangular prism, of which, in the second figure, the lateral edges are replaced (the plane T totally disappearing) by the planes *d* 1, 2, and 3, and the dotted lines include one, of several similar portions, contributing to form the macled crystal on the right of it.

M on M′	118°30′
— — *d* 1 or *d* 1	145.30
— — *d* 2 or *d* 2	126.16
— — *d* 3 or *d* 3	110.30
M′ on M″ (re-entering angle)	175.30

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* Witherite, after Dr. Withering, its discoverer.

+ Barytes, from the Greek, signifying heavy; in allusion to the great specific gravity of the earth.

It was discovered by Dr. Withering, who first noticed it at Anglesark in Lancashire, in a vein, with sulphuret of lead, and some of the ores of zinc, traversing a stratified mountain, composed of beds of sandstone, slate, and coal; the carbonate of barytes is chiefly found in the lower part of the vein, the sulphate nearer the surface: the carbonate occurs in this vein in globular masses, having a radiated structure.

It occurs abundantly in the lead veins of the north of England. Crystallized incrusting galena, blende, and limestone, in Alstone moor, where also a stalactitic variety is found; and it forms the common matrix of galena in Arkendale, but rarely occurs further north: at Snailbach mine in Shropshire in large irregular masses, in a lead vein, passing through greywacké slate: also at St. Asaph in Flintshire.

CIV (286

It has also been found in Stiria, in Salzburg, and the Altaic mountains in Siberia.

LXX (28

HEAVY SPAR. SULPHATE OF BARYTES.

LXXI (2

Schwerspath W. Baryte sulphatée crystallisée H. Lamellar heavy spar J.

It occurs both massive and crystallized, with a lamellar structure, which in the massive is sometimes curved; the crystals are divisible into the form of a right rhombic prism, which therefore is the primary crystal; occasionally however the crystals admit of division parallel to the lesser diagonal of the prism; but this is not a regular cleavage, as a close inspection of the uneven plane so produced, will evince; the angles of the primary prism are, by the reflective goniometer, from fractured surfaces, 101° 42′, and 78° 18′: the lustre of the fragments is shining. It occurs transparent, white and opaque, yellowish or yellow, reddish, greenish grey, and bluish or blue; it is harder than carbonate of lime, but yields readily to the knife: it possesses double refraction, when held in a particular direction: its specific gravity is about 4.7, and it consists of 67 of barytes and 33 of sulphuric acid. Klaproth. It decrepitates briskly before the blow-pipe, but eventually melts into a hard white enamel.

LXXII (2
CCXCIV (
XCVIII (
XCV (2
CCXXXV (
CCCLXX (2
DXLVI (2
LXXII (
CLXXIII (

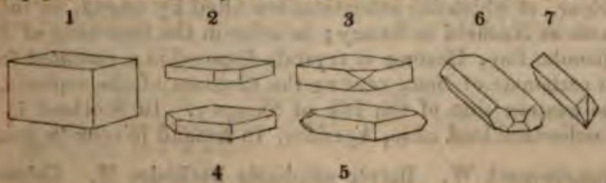
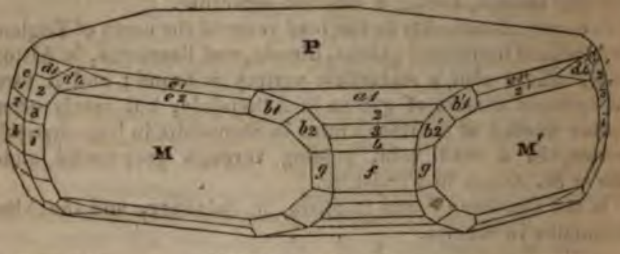


Fig. 1. The primary; a right prism with rhombic bases. Fig. 2. The same; of which the obtuse edges are replaced by planes parallel with those edges. Fig. 3. The same, of which each obtuse solid angle is replaced by a

triangular plane. In fig. 4, each acute edge of the prism is replaced by
XXXVIII quadrangular plane. In fig. 5, all the acute solid angles are replaced b
(300) triangular planes; which, in fig. 6, are so greatly increased, as to give th
crystal a prismatic form: in this figure, the triangular planes of fig. 3. ar
CCXXVIII also visible. In fig. 7 the triangular planes of fig. 5 are so greatly increase
as entirely to replace the primary terminal plane, and to reduce the primary
(301) lateral planes to small triangles.

CCCXXIV
(302)
CLXXVI
(303)
CLXXXII
(304)



P on *a*1	173°00′ *cg*	M or M′ on *i*	160°00′
— — *a*2	161.00 *cg*	— — — on *h*	128.55
— — *a*3	141.10	— — — on *d*3	141.00
— — *a*4	121.55	— — — on *d*2	154.00
— — *c*1	127.12	— — — on *d*4	126.00
— — *d*2 or *d*2′	124.00 *cg*	— — — on *f*	140.50
— — *d*3 or *d*3′	110.30	— — — on *g*	166.00
— — *d*4	143.00	*f* on *g* or *g*	153.00 *cg*
— — *e*1 or *e*1′	125.00	— — *a*4	148.10
— — *e*2 or *e*2′	115.30	— — *a*3	128.50
— — *f*	90.00	*h* on *i*	153.00 *cg*
— — *h*	90.00	*c*1 on *d*2	155.00 *cg*

It occurs in most countries of Europe, also in America; mostly in veins.

In England it occurs in the Dufton, Alstone moor, and Arkendale lead mines; in those of Derbyshire (where also it is said to occur in *stalactites*): in Cornwall, with yellow copper, in the United Mines, and in the mine called Ale and Cakes: at Matlock, it occurs in detached nodules just beneath the surface, and at Redland near Buxton. In crystalline masses of a yellow colour, of which the interstices are filled by quartz, in fuller's earth at Nutfield in Surrey; in veins in the limestone of Babbicombe Bay, Devon; in crystals disposed in a *radiated* form, on carbonate of lime, coating the divisions of the septaria, on the western side of the Isle of Sheppey. In Scotland in the Cumberland lead mine, Ayrshire. In Ireland in veins in granite.

Stangenspath W. Baryte sulphatée bacillaire H. Columnar Heavy Spar J. It occurs in rhombic prisms, which are not generally well defined, and which are laterally aggregated into columns. It is white, greenish, or greenish white, with a shining pearly lustre, and translucent. Its structure is lamellar.

It occurred near Freyberg in Saxony; and also, it is said, in Derbyshire.

Fibrous Heavy Spar. Baryte sulphatée concretionée-fibreuse. It occurs in somewhat botryoidal or reniform masses, of a fibrous structure, a shining resinous lustre, and of a chesnut brown colour. It is translucent on the edges and brittle. It consists of sulphate of barytes 99, and a trace of iron. Klaproth.

It occurs at Neulingen in the Palatinate, and at Chaudefontaine near Luttich, in the department of Ourthe.

Bolognian Stone. Bologneser spath W. Baryte sulphatée radiée H. It occurs in roundish masses, composed apparently of minutely fibrous crystals radiating from the center. Internally it is shining or glistening, and of a grey or yellowish grey colour: it is translucent on the edges, and the fragments are wedge-shaped, and soft. It is remarkably phosphorescent when heated.

It occurs imbedded in marle in Monte Paterno near Bologna;* also at Rimini; and in Jutland.

Granular Heavy Spar. Baryte sulphatée granulaire H. It occurs massive; the structure is finely granular, the grains being lamellar and crystalline; the lustre is shining; it is feebly translucent, and of a white, yellowish or greyish white colour. It consists of sulphate of barytes 90, silex 10. Klaproth.

It is found in Peggau in Stiria, and Schlangenberg in Siberia. In Ireland, on the sea-shore near Clonakilty.

Cawk.† It occurs massive, with a coarse earthy fracture, and is opaque, or rarely translucent on the edges. It is white, greyish white, yellowish, or reddish, and is glimmering or dull, soft, and brittle. Specific gravity 4.81. XCVI (305

It occurs in Bohemia, Saxony, the Hartz, &c.

It is found in Staffordshire, and in the lead mines of Derbyshire; it sometimes contains small veins of galena.

Earthy. It consists of dull or glimmering earthy particles, which cohere slightly, or are loose; and are meagre to the touch and heavy.

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* Whence Bolognian Stone.

† The name of Cawk is said to have been given to this substance from its resemblance to chalk.

It occurs in Saxony, Bohemia, and Westphalia.

It is found in cavities in veins of heavy spar in Staffordshire and Derbyshire.

1 HEPATITE.*

Hepatit Reuss. Baryte sulfatée fetide H.

This mineral occurs in lamellar and globular masses, of a yellowish, brownish, or blackish colour, giving out a fetid sulphureous odour on being rubbed or heated; its other characters agree with those of heavy spar. It consists of 85.2 of sulphate of barytes, 6 of sulphate of lime, 1 of alumine, 5 of oxide of iron, and 0.5 of carbon. Klaproth.

It has been met with at Andrarum, and in the silver mine of Kongsberg in Norway with native silver; at Lublin in Galicia; and in Albermarle county, North America.

It is said to have been found at Buxton in Derbyshire.

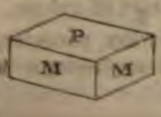
STRONTIANITE.† CARBONATE OF STRONTIAN.

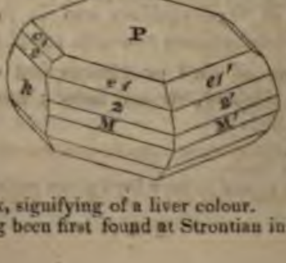
Strontian W. Strontiane carbonatée H.

LXV (306)

It occurs massive, fibrous, stellated, and regularly crystallized in the form of a hexahedral prism modified on the edges, or terminated by a pyramid; the primary crystal being a right rhombic prism of 117°.32′ & 62°.28′, by measurements taken by means of the reflective goniometer on planes produced by cleavage, to which the crystals readily yield parallel to the lateral planes of the prism; but regular crystals are rare. The structure of the massive is fibrous, sometimes divergent, with a shining pearly lustre; it is translucent, yields easily to the knife, and is brittle. It is of a greyish or greenish colour, sometimes brownish or deep brown. Specific gravity, 3.67. It is composed of 69.5 of strontian, 30 of carbonic acid, and 0.5 of water. Klaproth. It is infusible, except on the surface, before the blow-pipe, but becomes white and opaque, and tinges the flame of a dark purplish red. It is soluble with effervescence in muriatic or nitric acid.

Primary.





M on M′ ......117°.32′
—— h.......121 .30
e′ on e1′......108 .12
e1 on e2 or e1′ on e2′ } .144 .20
h on e1.......126 .5
—— e2.......143 .20
e1 on e2 ......160 .35

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* From the Greek, signifying of a liver colour.

† From its having been first found at Strontian in Scotland.

It was first discovered at Strontian in Scotland in a vein passing between gneiss and granite, with fragments of the latter interposed, and accompanied by galena, heavy spar, calcareous spar, and iron pyrites.

It occurs at Braunsdorf in Saxony, and in Peru.
Leogang in Salzburg S. CXLII

73

BARYSTRONTIANITE or STROMNITE.

Dr. Traill.

It has been found in masses, of a greyish white colour externally, where it appears somewhat disintegrated, but approaches to yellowish white internally, where its lustre is weakly shining and pearly. It is translucent on the edges; brittle and soft. Its specific gravity is 3.703. It effervesces with acids, but does not melt before the blow-pipe. Analysis by Dr. Traill, carbonate of strontian 68.6, sulphate of barytes 27.5, carbonate of lime 2.6, oxide of iron 0.1, loss 1.2.

It was found in veins or rather nests, accompanied by galena, in a rock described by Professor Jameson, as "intermediate between schist-ore and indurated clay" resting on mica-slate, at Stromness[*] in Orkney; but late attempts to find this mineral have been ineffectual.

CELESTINE. SULPHATE OF STRONTIAN.

CXVII (30

Celestin W. Strontiane sulphatée H.

This mineral is white, greyish-white, yellowish-white, or reddish or red; also of a delicate blue:[‡] it occurs massive, fibrous, stellated, and crystallized; the primary form is a right rhombic prism of 104° and 76° by measurements with the reflective goniometer from the planes produced by cleavage; the transparent crystals are pretty readily divisible by mechanical means into that form. It possesses a shining lustre; and is translucent, transparent, or opaque. It is harder than heavy-spar, but is scratched by fluor-spar, and is brittle. Its specific gravity is 3.6. It is composed, according to Vauquelin, of 54 strontian, and 46 sulphuric acid. That of Fassa in the Tyrol by the analysis of Dr. R. Brandes, consists of sulphate of strontian 92.14, sulphate of lime 1.33, sulphate of barytes 1.87, carbonate of strontian 1.64, carbonate of lime 0.50, silex 1.00, oxide of iron 0.50. Analysis by M. Gruner of a crystallized specimen

CXVIII (30

CCCCXLV (30

CCCXIX (31

CCCXI (311)

CCXII (312

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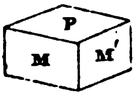
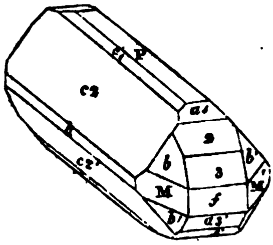
[*] Whence Stromnite; Barystrontianite doubtless from its containing both barytes and strontian.

[‡] Sometimes approaching to a sky-blue colour, whence Celestine.

from Norten in Hanover; sulphate of strontian 73.000, sulphate of barytes 26.166, ferruginous alumine 0.213. Sulphate of strontian melts before the blow-pipe into a white, opaque, and friable enamel.

Primary.





M on M'......	104°00'
P on M or M'	90.00
P on c1......	174.32
— — c2......	128.14
— — h.......	90.00
— — a1......	157.54
— — a2......	140.32
— — a3......	127.48
— — f	90.00
M on b	154. 2
— — f	142. 5
c2 on c2'.....	105.20

It occurs in slaty clay at Monte Martre near Paris, together with a *compact* variety containing about 8 per cent. of carbonate of lime: in a bed in a coal mine in Hanover: at Bex in Switzerland: in basaltic amygdaloid in the Vicentine: in gypsum with sulphur in Sicily, and near Cadiz; in layers in a brownish grey slate near Frankstown in Pennsylvania: at Dorneberg near Jena in beds of marle.

X 313) Near Bristol it occurs in the red marle formation, stellated, on carbonate of lime in digging the foundation of houses; crystallized at Aust Passage; in the crevices of yellow sandstone at Redland; near Brislington; also in cavities in the Black Rock near Bristol with fluate of lime and calcareous spar: with calcareous spar, lining the septa or divisions in lenticular masses of limestone, lying in a slaty clay between beds of limestone not far from Watchet on the coast of Somersetshire; in minute transparent crystals on sulphate of lime, in the new red sandstone on the coast of Devon near Sidmouth. In Barry Island on the coast of Glamorganshire. On the banks of the Nidd near Knaresborough in Yorkshire in limestone: of a pale blue, radiated, the surface crystallized, at Burton in Westmoreland. Crystallized, in red sandstone at Inverness, in Scotland.

ACIDIFEROUS ALKALINE MINERALS.

Under this head are included such Minerals as consist chiefly of an Alkali united with an acid; but several of them are very impure in their native state.

NITRE. NITRATE OF POTASH.

Naturlischer Salpeter W. Potasse nitratée H.

Nitre or Saltpetre occurs in crusts, and in capillary crystals, of which the forms are not discernible; it is whitish or of a yellowish white; is translucent or transparent; brittle; saline, and cooling to the taste: it deflagrates when placed on a hot coal.

It occurs on or near the surface of the earth, and on old walls, &c.

It is found on many of the plains of Spain; and on the chalk near Evreux in France, from which it is gathered seven or eight times every year; and in the deep grottos of Mont Homburg, in Germany. In Italy it is afforded by the calcareous soil of Molfetta. Hungary, the Ukraine, and Podolia furnish Europe with abundance of nitre. In Arabia it occurs in a valley between Mount Sinai and Suez. Persia affords it, and it is very common in India, especially on a large plain about 60 miles from Agra in Bengal, which is said to have been formerly well peopled. It is found at the Cape of Good Hope. The mountainous regions of Kentucky, which are calcareous and full of caverns, afford it to the inhabitants of North America. In South America, the plains bordering the sea, near Lima, are covered with it.

But Nitre is not naturally produced in sufficient quantity for its multiplied uses. It is therefore procured artificially. In order to this, heaps of rubbish, of plaster and of earth, with dung and other vegetable matter, are placed under sheds; these are moistened with various animal fluids, as blood, &c. and the mass is then exposed to rot in the air. The consequence seems to be, that the azote disengaged by the putrefaction of the animal matter, combines with the oxygen of the atmosphere, producing nitric acid; which, by uniting with the potash of the vegetable matter, forms nitre. This is afterwards purified.

Nitre is employed in medicine, the arts, and in metallurgy, for assisting the processes of oxidating and smelting; but its principal if not its chief use is in the manufacture of gunpowder, for which that imported from Egypt is most esteemed, as it contains the least calcareous matter. Gunpowder consists of 76 parts of nitre, 9 of sulphur, 15 of light charcoal.

Nitrate of Soad Peru.

NATRON.* CARBONATE OF SODA.

Natürlisches Mineralalkali W. Soude carbonatée H.

It is found crystallized, massive, fibrous, and sometimes radiated, in crusts, and efflorescing. The massive is compact or granular, of a glistening lustre, and translucent, but by exposure becomes opaque. The fibrous appears to consist of an aggregation of minute crystals, having a glistening and vitreous lustre, and sometimes disposed in a radiated form; it is translucent: the colour is grey or yellowish white: to the taste it is urinous and saline. The radiated variety *(Trona)* consists of carbonate of soda 75, sulphate of soda 2.50, water 22.5: it effervesces violently with acids, and is usually mixed with common salt and Glauber's salt in various proportions.

It is met with either dissolved in the water of certain hot springs, as those of Carlsbad in Bohemia, and Rykum in Iceland, or in certain lakes, as in Egypt and Hungary; or in the state of a solid salt found beneath the surface of the soil. Pure carbonate of soda by analysis yields 22 of soda, 15 carbonic acid, 62 water.

Trona is found between Tripoli and Fezzan in Africa; and according to Dr. D. Munro, in a stratum only one inch thick, in contact, both above and below, with muriate of soda (common salt). It is collected to the amount of hundreds of tons annually. It rarely reaches Europe. Trona consists of 37 soda, 38 carbonic acid, 22½ water, 2½ sulphate of soda.

Natron is procured from the lakes of Egypt and Hungary. The former are six in number, situated in a barren valley, called Bahr-bela-ma, about 33 miles westward of the Delta. The soil consists of calcareous rock, mixed with gypsum and covered with sand. These lakes contain both the muriate and carbonate of soda, and the edges of the lakes are surrounded by a band some yards in breadth, of these substances, chiefly of the latter; but the principal accumulation is at a little distance from the bank. It is taken out and exported in that impure state.

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* Natron; from the desert of Natron, where it is said to have been anciently collected.

The lakes of Hungary are four in number, and lie between Dobritzin and Groswaradin; they are much neglected. The soil is a stiff blue clay covered by white calcareous sand. The lakes are from one to two miles in circumference, and in the winter are full of water: about April they are generally dry, and the saline efflorescences of natron, mixed with a little sulphate of soda, appear; which, being gathered, reappear in three or four days; this kind of harvest continues till towards the end of October, when winter begins, and the lakes become full of water. The Natron, both of Egypt and Hungary, is imported in pulverulent masses of a dirty grey colour.

GLAUBER SALT. SULPHATE OF SODA.

Naturlisches Glaubersalz W. Soude sulphatée H.

Sulphate of Soda is found in efflorescences of a yellowish or greyish white colour, or in an earthy form, but is more commonly dissolved in certain mineral waters: it is cooling, bitter and saline to the taste, and is most usually met with in the neighbourhood of rock-salt or brine springs. Pure sulphate of soda consists of 27 of sulphuric acid, 15 of soda, and 58 of water.

Sulphate of Soda is found in many of the lakes of Austria, Lower Hungary, Siberia, and Russia, and in Switzerland; near Madrid in Spain it occurs in efflorescences at the bottom of a ravine, and it is said to form an ingredient of the waters of the Tagus. It has been found in the workings of old mines near Grenoble in France, and sometimes on old walls in the same manner as nitre. It is also found in the ashes of some vegetables, especially of sea-weeds, of the tamarind, and of some kinds of turf; and is therefore not an uncommon substance. When purified of the iron with which it is usually tinged in the native state, or when prepared artificially, it is used in medicine under the name of *Glauber's Salt.*

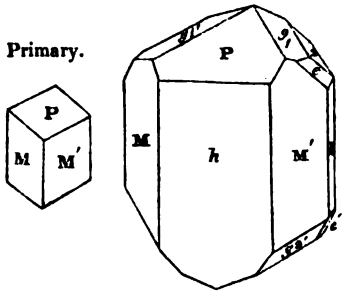
NITRATE OF SODA.

This salt is described by Mariano de Rivero in the Ann. des Mines, for 1821, p. 596, as occurring in immense quantity in the district of Tarapaca in Peru, near the frontiers of Chili, three days journey from La Conception, a port in Chili, and from Iquiqui a port on the south of Peru. It there forms a bed many feet thick, which in many places appears on the surface and occupies an extent of more than forty leagues. The salt appears occasionally as an efflorescence, sometimes crystallized, more often intermixed with clay and sand; to the taste it is cool and bitter; it is deliquescent, and when exposed to heat it behaves like nitrate of potash; it contains a little sulphate of soda. Very large quantities of this salt purified by solution and crystallization, have already been imported into Europe.

BORATE OF SODA. BORAX. TINCAL.

Soude Boratée H.

Tincal occurs in prismatic crystals, variously terminated; CXXV 74 and yielding to mechanical division parallel to the lateral planes of the primary form—an oblique rhombic prism of about 86°. 30′ and 93° 30′, and both its diagonals. The crystals are whitish, occasionally possess a tinge of blue or of green, and vary from translucent, or nearly transparent, to opaque. It is soft and brittle. It consists of boracic acid 36, soda 17, water 47. Before the blow-pipe it intumesces violently, and according to Berzelius, carbonizes, gives off an empyreumatic odour, and then fuses into a transparent globule.



M on M	86°30′
P on M or M	101.30
M or M′ on h	133.20
M′ on h	136.45
— — e	138.12
P on h	106.30
— — g1	139.15
— — g2	115.30
— — e	114.28
e on g2	141.52

Tincal is chiefly, if not only, brought from Thibet, where it is procured from a lake which is entirely supplied by springs, and is fifteen days journey from Tisoolumbo the capital. The water contains both borax and common salt, and being in a very high situation, is frozen the greater part of the year. The edges and shallows of the lake are covered with a stratum of borax, which is dug up in considerable masses, and the holes thus made are gradually filled by a fresh deposition: from the deeper parts of the lake common salt is procured. The borax in its rough state is called *Tincal*, and is brought to Europe in the form of a brownish grey impure salt; or in detached crystals in the form of the preceding figure.

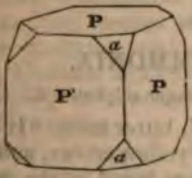
But it is said also to be found in the island of Ceylon, in Tartary, in Transylvania, and in Lower Saxony, and abundantly in the province of Potosi in Peru.

The purification of Borax is an art confined only to a few chemists.

COMMON SALT. MURIATE OF SODA.

XXII (31

Rock Salt is found in beds or masses; sometimes crystallized in the form of the cube, which is that of its primary crystal, and into which pure Rock Salt may readily be cleaved; when impure, as when its brown colour is derived from an intermixture of clay, its structure is less determinately lamellar; its lustre is shining or vitreous; it is either opaque, translucent, or transparent, and its colour is very various, as white, grey, reddish brown, brick red, violet, blue and green; when coloured, it is always more or less impure. It yields readily to the knife; its specific gravity is 2.54; pure muriate of soda, according to Berzelius, is composed of 46.55 of muriatic acid, and 53.44 of soda; 1000 parts of the Rock Salt of Cheshire consist of muriate of soda $983\frac{1}{4}$, sulphate of lime $6\frac{1}{2}$, muriate of magnesia $0\frac{3}{16}$, muriate of lime $0\frac{3}{16}$, insoluble matter 10. It is sometimes, though rarely, of a fibrous texture.



P on P or P	90°00′00″ H
P P or P on *a* ..	125.15.52 ..
a on *a*	109.28.16 ..

Muriate of Soda is one of the most abundant substances in nature; not only is it found in large beds and masses, but also in the waters of certain springs and lakes; and in those of every sea. It forms about one-thirtieth part of the waters of the Ocean.

Rock Salt is commonly disposed in thick beds; either superficial, as in Africa, or of a very great depth, as in Poland: sometimes they are very high above the level of the sea, as in the Cordilleras of America, and also in Savoy; where they are found at an elevation equal to that of perpetual snow. In Spain, Rock Salt occurs in vast masses, which seem to be isolated.

Sulphate of lime, or gypsum, almost always accompanies Rock salt; and is sometimes so impregnated by it, as to be worked as a salt mine, as at Arbonne in Savoy.

Red or greyish clay frequently alternates in beds with Rock salt; but blocks or masses of clay are said more often to be enclosed in it: when in beds, the clay is accompanied by sand, grit-stone, and rounded pebbles, and by compact carbonate of lime, which is sometimes fetid, sometimes bituminous. Rock salt commonly rests upon sulphate of lime, and is covered by carbonate of lime. In the beds of various substances which accompany it, are sometimes found the remains of organized bodies, the bones of elephants, and other mammalia, carbonized wood, fossil-shells, and bitumen; and frequently masses of sulphur are found in the sulphate or carbonate of lime.

Several countries in Europe abound in Rock salt and Salt springs; Spain, Germany, Italy, part of Russia, &c.; from the springs at Droitwich in Worcestershire, 16,000 tons of salt are annually procured: and 156,000 tons of rock salt are annually raised from the great deposit near Northwich in Cheshire. In France there are many salt springs, but no known deposite of salt. Sweden and Norway are without salt. It is abundantly found in many countries of Asia, Africa, and America.

Salt lakes exist in the isles of Cyprus and Milo in the Mediterranean: abundantly in the peninsula of the Crimea: near Alexandria in Africa, and in the country of the Hottentots and Caffres; and in North America.

SULPHATE OF AMMONIA.

Mascagnin, Karsten. Ammoniaque sulphatée H.

Sulphate of Ammonia has an acrid, bitter taste. It occurs in the form of stalactites, of a greyish or yellow colour, and covered by a whitish farina-like dust; they are found in the fissures of the earth surrounding certain small lakes near Sienna in Tuscany. It consists of 40 per cent. of ammonia, 42 of sulphuric acid, and 18 of water. It is also found among the lavas of Etna and Vesuvius; in the Solfatara; and in a spring in Dauphiné.

SAL AMMONIAC. MURIATE OF AMMONIA.

Naturlischer Salmiack W. Ammoniaque muriatée H.

1.11
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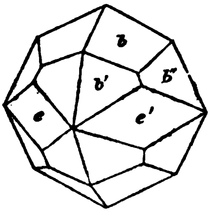
It occurs massive with a fibrous texture, plumose, in crusts, and in regular crystals of which the cube is esteemed to be the form of the primary crystal; the crystals are always small. It occurs white, grey, yellow, green and brownish black. It is pungent and saline to the taste; varies from transparent to opaque; externally is dull or glistening; internally shining and vitreous. That of Vesuvius consists of muriate of ammonia 99.5, muriate of soda 0.5. Klaproth.



e on e'	90°00′
e' on b' or b''	150.00
b' on b'' b on b' or b on b''	146.10
b on e'	125.00

No one of the primary planes of the cube is visible on the above figure,—the planes b b' and b'' replace its solid angles, and the planes e e its edges. See Leucite.

This salt is characterized by its insolubility in water, and by the ammoniacal odour which it gives out when triturated with lime, better than by any of its external characters. It sometimes exists in the substances which enclose it, in such a manner, as to be without the reach of the eye or the touch.

It is principally found in the neighbourhood of volcanoes, sublimed in the cracks of lava, among other volatile matters near their craters. It thus occurs in the lavas of Etna and Vesuvius. At Solfatara it escapes in bubbles, which are caught and condensed in long earthen pipes. It is said to appear in efflorescences on certain rocks in Turquestan in Persia, in Calmuc Tartary, Bucharia and Siberia; in some lakes of Tuscany, and certain springs of Germany; and in some English coal, especially that of Newcastle.

A variety, of greyish white colour, and conchoidal fracture, is said to occur, with sulphur, in rocks of indurated clay or clay-slate in Bucharia.

ACIDIFEROUS ALKALINO-EARTHY MINERALS.

The Mineral substances included under this head are but very few in number.

ALUM.*

Naturlischer alaun W. Alumine sulfatée alkaline H.

It chiefly occurs as an efflorescence on argillaceous minerals, as alum-slate, alum-stone, on certain slate-clays, likewise on lavas. It is said also to occur in stalactites, in delicate capillary crystals, and massive with a fibrous texture and a silky lustre: it is white, or yellowish or greyish white; to the taste it is sweetish, styptic, and acidulous. That of Freinwald consists of alumine 15.25, sulphuric acid and water 77, potash 0.25, oxide of iron 7.50. When artificially prepared it crystallizes in the octohedron, which is its primary form, and in some of its varieties.

It is found on the alum slate rocks near Christiana in Norway; in coal mines in Bohemia, Bavaria, Italy, &c. and on the lava of Stromboli, &c.

In Scotland, in alum-slate near Moffat in Dumfries-shire, Ferry-town of Cree in Galloway; on bituminous shale and slate-clay at Hurlet near Paisley. In England, in and upon slate-clay near Whitby in Yorkshire.

ALUM-STONE.

Alaunstein. W.

The colour of this mineral is usually a greyish white, occasionally also red, and it occurs both massive and crystallised, the crytals being generally situated in the cavities of the massive substance: they are minute, shining, and sometimes brownish,

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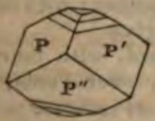
* Alum, from its base consisting of alumine.

externally. They occur in the form of an obtuse rhomboid of 92° 50′, and 87° 10′, by the reflective goniometer, by the measurement of its natural planes; but the rhomboid is variously modified, one or more of the solid angles being generally replaced. The massive is translucent and easily frangible. It scratches carbonate of lime, but is scratched by the fluate. Specific gravity, 2.5—2.7. Analysis by Vauquelin, alumine 43.92; silex 24.00; sulphuric acid 25.00; potash 3.08; water 4.00. Analysis of the crystalline of Tolfa, by Cordier, alumine 39.654; sulphuric acid 35.495; potash 10.021; water and loss 14.830; oxide of iron a trace. It decrepitates under the blowpipe; by a continuation of heat it emits a gas sensibly sulphureous, but if afterwards placed on the tongue it absorbs moisture, with a strong taste of alum. It finally, under the blowpipe, does not melt, but becomes insipid.



P on P′ .... 92°50′
P on P′ on P″.. 87.10

It occurs in a secondary rock at Tolfa, near Civita Vecchia, a port about 35 miles from Rome, in small masses and veins, and according to Cordier exists in almost all burning volcanoes.

CRYOLITE.*

Kryolith W. Alumine fluatée alkaline H.

It occurs massive, white, or greyish white, and occasionally brown, from an admixture of iron; the structure is perfectly lamellar, with joints parallel to all the planes of a rectangular prism. This substance is not so hard as fluor spar, and is translucent; but by immersion in water, it becomes transparent. Its spec. grav. is 2.94; and it consists of 21 of alumine, 32 of soda, and 47 of fluoric acid and water. Vauquelin. Before the blow-pipe on charcoal it fuses into a transparent globule, which becomes opaque on cooling.

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It has been found only in thin layers in gneiss, in the Fiord, or arm of the sea, named Arksut, in West Greenland, accompanied by carbonate and sulphuret of iron, galena, crystals of quartz, and more rarely of felspar.

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* Cryolite, from the Greek, in allusion to its easy fusibility—to its melting before the blow-pipe like ice.

AMBLYGONITE.*

Amblygonit. Leonhard.

This mineral occurs, according to Leonhard, in rhombic prisms of 106° 10′ and 73° 50′, which are rough externally, and of a greenish white, or of a mountain, or sea-green colour. It cleaves parallel to the sides of the prism with brilliant surfaces, and when reduced to their laminæ, it varies from translucent to transparent. Its hardness is about equal to that of felspar, but it may be scratched by quartz. Specific gravity 3.00 to 3.04. According to Berzelius (‘ Blow-pipe’ p. 297) it consists of alumine, lithia, and the phosphoric and fluoric acids, and he describes it as a double sub-phosphate of alumine and lithia, containing fluoric acid. On charcoal it fuses easily into a clear glass, which becomes opaque on congealing; with borax it fuses readily into a transparent colourless glass.

It is found, according to Leonhard, with tourmaline and topaz, in newer granite at Sachsen, near Penig, in Saxony. Berzelius gives its locality as Chursdorf in Saxony.

GLAUBERITE.†

Glauberite Bt. H.

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It occurs massive; also crystallized in the form of oblique and extremely flat rhombic prisms, the crystals being for the most part constituted only of the planes P, *e*, and *e*′ of the following figure; but they yield readily to mechanical division, parallel to the planes P, M, and M′, the primary form being an oblique rhombic prism, whose terminal planes incline from one acute edge of the prism to the other, and whose lateral angles are alternately 83° 20′ and 96° 40′, the angles of the terminal on the lateral planes, being alternately 104° 15′ and 75° 45′, by the reflective goniometer from cleavage planes; its colour is a pale yellow or grey; it is translucent, rarely transparent, and is less hard than calcareous spar, but harder than gypsum: its spec. grav. is 2.7. and it is composed of 49 per cent. of sulphate of lime, and 51 of sulphate of soda, according to Brongniart. It therefore contains no water of crystallization; when immersed in water, it becomes opaque and is partly soluble. Before the blow-pipe it decrepitates, and then melts into a white enamel.

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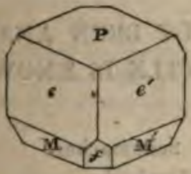
* Amblygonite, from the Greek, in allusion to the obtuse angles of its prism.

† From its containing a very large proportion of Glauber's salt, or sulphate of soda.



M on M′	83°.20′
P on M or M′	104 .15
—— *e* or *e*′	137 .09
—— *f*	112 .20
M on M′ on *f*	131 .35
M on *e* or M′ on *é*	147 .40
e on *e*′	116 .20
e or *e*′ on *f*	132 .37

It is found at Vela Rubia, 10 leagues south of Madrid in Spain, imbedded in rock-salt; more lately in the blue salt of Ischel of Upper Austria.

POLYHALLITE.*

Stromeyer.

It occurs in shapeless masses, which are partly compact, partly of a fibrous texture, the fibres being parallel and mostly curved. The more compact is often colourless and transparent, yielding to cleavage readily, parallel to all the planes of the cube, with brilliant surfaces affording 90° every way by the reflective goniometer; the fibrous in the mass is of a brick red colour and somewhat translucent. It is brittle, but scratches calcareous spar easily, anhydrite slightly; it is easily scratched by fluor. Its spec. gr. is 2.77 nearly. When fibrous it has a pearly lustre in a slight degree. It is slightly acted upon by exposure. In the flame of a common candle it immediately becomes an opaque mass of a brownish colour; and melts instantaneously under the blow-pipe. Analysis by Stromeyer; sulphate of lime combined with water 28.25: anhydrous sulphate of lime 22.42; anhydrous sulphate of magnesia 20.03; sulphate of potash 27.70; muriate of soda 0.19; red oxide of iron 0.34.

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It has been found at Ischel, in Upper Austria, not far from the borders of Salzburg, in beds of rock salt.

A mineral is noticed by Leonhard under the name of *Bloedit* (after the Dresden mineralogist Bloede) as occuring at Ischel with the Polyhallite. He describes it as being soft, of a close fibrous texture, of a colour between flesh and brick-red; as being transparent and brilliant, but as losing both these characters by exposure.

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* From the Greek, signifying a stone of many salts, in allusion to its composition.

MINERALS WHICH HAVE NOT BEEN ANALYSED, OR OF WHICH BUT LITTLE IS KNOWN.

BERGMANNITE.* Schumacher.

Var. of Wernerite, Leonhard.

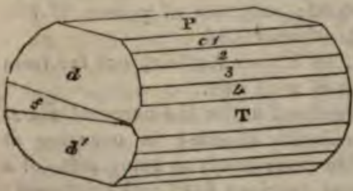
It occurs massive, and is of a greenish or greyish white, or
·LXVIII reddish. The fracture is various, mostly fine grained, which
may in part be owing to its being, as by Haüy it is considered
80 to be, a mixture of different earthy substances. It melts under
the action of the blow-pipe into a translucent glass.

It occurs at Frederickswarn in Norway in a bed of quartz, and in felspar.

BREWSTERITE.†

H. J. Brooke.

This mineral was, until lately, considered as an Apophyllite. It occurs in small prismatic crystals, terminated generally by two planes (*d d* of the following figure,) and attached to the matrix at the plane *f*, or the opposed plane; it is nearly colourless and transparent, or semitransparent and of a yellowish tinge. The crystals cleave readily and with brilliant surfaces parallel to the plane P, and apparently at right angles to it, but not with sufficient accuracy for admeasurement. The primary form, which therefore is only deduced from the secondary planes, appears to be a right oblique-angled prism.



P on *d*	93°.50′
—— c1	119 .30
—— c2	114 .30
—— c3	112 .00
—— c4	92 .00
T on *f*	94 .20
d on c2	95 .00
d on *d*′	175 .00

It has been found only at Strontian in Scotland, generally accompanied by calcareous spar.

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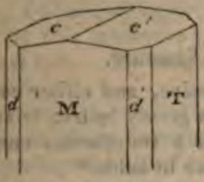
* In honour of Bergmann, the celebrated Chemist.

† In honour of Dr. Brewster.

COMPTONITE.*

Dr. Brewster.

The Comptonite is found only in small crystals, which are whitish and translucent, or white and opaque, and which yield to mechanical division parallel to the planes M & T of the following figure; the primary form is a right rectangular prism, of which the bases are not square. It scratches stilbite but not mesotype. It has not been analysed. By exposure in the form of powder to the action of nitric acid, it is convertible into a jelly.



M on T........	90°00′
T on c′........	93.00
c on c′........	177. 5
M on d′........	135.35

It occurs lining the cavities of an amygdaloidal rock on Vesuvius.

CHIASTOLITE.‡

Hohlspath W. Chiastolith, Reus. Macle H.

This mineral has only been met with in apparently rectangular prisms, composed of two distinct substances. The exterior is greyish white; the interior is black or bluish black, and its sides are in general parallel with those of the exterior substance, which in some specimens is so thin as to form a mere coating. From each of the angles of the interior prism, there often proceeds a black line which sometimes reaches the corresponding angles of the coating, but is sometimes terminated by a black prism; so that the chiastolite occasionally consists of five black prisms, communicating by black threads, and as it were imbedded in a greyish white or reddish substance, which is translucent, hard enough to scratch glass, possessing a lamellar structure occasionally, and exhibiting by cleavage brilliant planes, which by the reflective goniometer meet so nearly at right angles, as to differ only a few minutes from 90°. Alone before the blow-pipe it is infusible; with borax it fuses with extreme difficulty even in powder, into a transparent glass.

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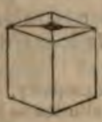

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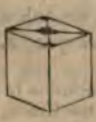

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* In honour of Lord Compton.

‡ Chiastolite, from the Greek, in allusion to its being marked with the form of an X, in dark lines, visible on the summits of the crystals.

This substance seems only to have been discovered imbedded in argillaceous or micaceous schistus.

It is met with in the Sierra del Marao in Portugal. The chiastolite is also found in Brittany in France, in the valley of Barège in the Pyrenees, also at St. Jaques de Compostella in Spain. In several places in the United States of America.

In England it occurs in the Wolf-crag near Keswick in slate; in Cornwall, and on Skiddaw in Cumberland, in clay-slate; and at Agnavanagh, and Baltinglass-hill, in the county of Wicklow in Ireland.

CHUSITE. Saussure.

It is described as occurring massive, and either compact, or with a granular texture; it is of a greasy lustre, is translucent and fragile; it melts easily into a translucent enamel, and dissolves entirely with effervescence in acids.*

It was found by Saussure in the cavities of porphyritic rocks near Limbourg; and also in Switzerland.

CHLOROPHÆITE.†

Dr. MacCulloch.

This mineral, when newly broken, is of a green colour, varying from the fine transparent yellow green of olivin, which it sometimes resembles, to the dull muddy green of steatite, to which it then bears an equal resemblance. After a few hours exposure it turns darker, and shortly becomes black; a change which also occurs within the rock, at the depth of an inch or more from the surface. In this case the transparent variety has mostly the aspect and lustre of jet, but is sometimes of the fine brown orange of cinnamonstone, or a rich bottle or olive green; while the opaque preserves its dull surface, and more nearly resembles black chalk, but small fragments transmit light; when powdered, the one is of a snuff-brown, the other of a dirty olive. The fracture of the transparent variety is generally conchoidal; of the dull variety, intermediate between the conchoidal and granular. It is so soft as to be scratched by a quill, and is brittle; specific gravity 2.020. Before the blow-pipe it remains unchanged, neither cracking nor sensibly altering its colour nor translucency; and is apparently as refractory as quartz. It is acted on by the muriatic acid, giving indications of a considerable portion of iron, with a little alumine, but silex appears to be its principal constituent. There are no traces of lime or manganese.

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* Whence Chusite, in allusion to this property.

† Chlorophæite, from the Greek, in allusion to its appearing of a green colour (when newly broken).

It is found imbedded in the amygdaloids of the cliff of Scuirmore in the Isle of Rum, the base being either a basalt or a black indurated clay-stone. It is also found in Fife. The nodules are generally round, and vary from the size of a radish seed to that of a pea and upwards. Occasionally they are oblong and compressed, and sometimes scale off in concentric crusts. In a few cases they are hollow, the interior surface having a blistered aspect; or the cavity of the amygdaloid is covered by this substance: more rarely it invests spherules of calcareous spar. By long exposure it assumes the form of a rusty powder.

Dr. MacCulloch, the discoverer of this mineral, observes that it has since been brought from Iceland by Major Peterson.

It may perhaps be allied to the sideroclepte of Saussure.

COUZERANITE.

Couzeranit, Leonhard.

This mineral is described as occurring in rectangular prisms, of which the lateral edges are sometimes replaced by planes, occasionally so greatly as to impart to the crystal the form of a rhombic prism, having two of its lateral edges replaced; and it is described as varying in colour from greyish black to indigo blue, as being opaque, except when reduced to thin portions, which are transparent, and brilliant: the crystals are rarely separate, but mostly occur fasciculated: it is scratched by apatite. Before the blow-pipe it does not melt; in acid it becomes softer, but is insoluble.

It is said to occur in limestone in the country heretofore termed 'des Couzerans,'[*] in the steep defiles of Saleix, particularly on the sides of the road to Port d'Aulus; also at the Col de la Trappe, the Picou de Geu, the vallies of Eree and Ustone, and above Seix, on the road to Pont de la Taule; on the right bank of the Sallat, and between Seix and Sentenuc.

DOMITE.

The mineral, brought into this country under the name of Domite, is white, or greyish white, occasionally tinged externally of a yellow colour. It has the aspect and gritty feel of a sandy chalk, soiling the fingers when white, but possessing more of the appearance of a sandstone when of a grey tint; the latter includes scales of dark brown mica, and minute portions of a translucent and nearly colourless substance which is highly crystalline; both varieties are friable, particularly the former. The Dolomite is considered by some to be disintegrated or decomposed felspar.

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[*] Whence Couzeranite.

The grey occurs in the form of a large bed in the Puy de Dome* in Auvergne; the white constitutes the entire hill, Puy de Sarcuay, in the same neighbourhood, and is sometimes so hard as to be quarried as a building stone.

FUSCITE.

Fuscit, Schumacher.

This mineral is of a greyish or greenish black colour, and opaque; it crystallizes in prisms of which the natural planes are generally black and sometimes shining, and they are often closely aggregated. It yields to mechanical division parallel to the lateral planes of a rhombic prism of about 87° and 93°, apparently with inclined summits, in this respect greatly resembling the primary form of augite, of which it may perhaps prove to be a variety. Specific gravity 2.5—3. Before the blow-pipe it does not melt, but becomes shining, and enamel-like.

It is found at Kalligeren near Arendahl in Norway in rolled masses of granular quartz, accompanied by a small quantity of felspar and carbonate of lime.

HISINGERITE.

Hisingerit, Berzelius.

This mineral is mentioned (though but very imperfectly described) by Leonhard, as having received its name from Berzelius. It appears to be found massive, of a black colour, and affording a cleavage only in one direction; in other directions the fracture is earthy. Specific gravity 3.04. Analysis by Berzelius, oxide of iron 51.50, silex 27.50, alumine 5.50, oxide of manganese 0.77, a trace of magnesia, loss of moisture 11.75. Before the blow-pipe it soon becomes attractable by the magnet; by a continuation of the heat it is reduced to an opaque drossy globule; with borax to a yellowish green glass.

It occurs in the cavities of calcareous spar in Svärta parish in Sudermanland.

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* Whence its name of Domite.

HOLMITE.* Dr. Clarke.

This mineral was described by the late Dr. Clarke of Cambridge. Its specific gravity is remarkable, being 3.597. It occurred in a mass in the form of an oblique rhombic prism. It consisted of lime 27, carbonic acid 21, alumine 6½, silex 6½, oxide of iron 29, and water 10. Whence it may be concluded to be a variety of limestone; but its locality is not known, having been found among the paving-stones of Cambridge.

HUMITE.* Bournon.

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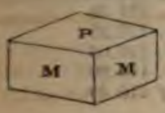
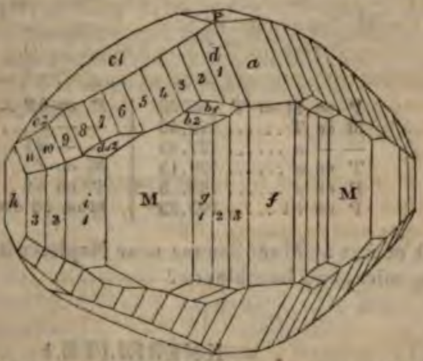
It occurs in very small crystals, which are of a deep reddish brown colour, and transparent or translucent, with a shining lustre. The crystals are modified in an extraordinary degree; their primary form may be considered as being a right rhombic prism of 60° and 120°, but they yield to mechanical division parallel only to its shorter diagonal, (i. e. to the plane *h* of the following figure.)

Primary.





M on M	120°00′	*h* on *d*4.....	119°24′	*h* — *i*2	140°56′
P on M or M..	90.00	— — *d*5.....	121.45	— — *i*3	143.20
— — *f* or *h*...	90.00	— — *d*6.....	125.30	*c*1 on *d*1......	155· 2
M on *h*	120.00	— — *d*7.....	129.46	— — *d*5......	159.10
— — *d*1......	118.12	— — *d*8.....	121.20	— — *d*7.....	159.30
— or M or *f*..	150.00	— — *d*9.....	124. 2	*d*1 on *g*3	116.25
P on *c*1	144. 1	— — *d*10....	136.16	*d*12 on *d*8	163.22
— — *c*2......	153.45	— — *d*11....	157.20	— — — *g*3	131.15
h on *a*	90.00	— — *g*3.....	100.40	*b*2 on *g*3	143.15
— — *d*1......	101.50	— — *g*2.....	103.40	*b*1 on M	137.00
— — *d*2......	103.42	— — *g*1.....	115.15	*f* on *a*	115.10
— — *d*3......	112.45	— — *i*1	133.36		

It is found on Somma with brownish mica.

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* In honor of the Rev. J. Holme.

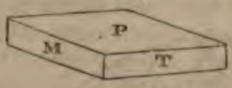
† Humite, in honour of Sir Abraham Hume.

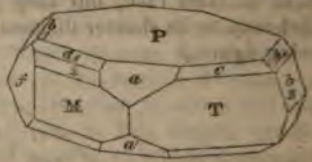
ICE-SPAR.*

Eis-path W.

It occurs both massive and in flattish crystals, of which the primary form is a right oblique angled prism, differing but little in its proportions from a right rhombic prism. It yields to mechanical division parallel to all the primary planes, but with difficulty parallel to the plane T, easily to P and M of the following figures. It is transparent or translucent, and of a grey or greyish-white colour—occasionally it is said yellowish or greenish-white. It possesses a shining lustre, and is very brittle. It has not been analysed. According to Berzelius, under the blow-pipe on charcoal it becomes vitreous, semi-transparent and white, and fuses with difficulty on the edge into a blebby semi-transparent glass; with borax into a diaphanous glass.

Primary.





P on M or T	90°00′	P on *b*2	120°30′
M on T	129.40	— — c	134.38
— — *a*	127.45	— — *d*1	116.35
T on *a*	128.15	M on *f*	150.00
P on *a*	138. 5	T on *b*2	112.20
P on *b*1	125.25	M on *b*2 over *f*	110.49

It occurs at Mont Somma near Naples with nepheline, meionite, mica, and hornblende.

KNEBELITE.†

This mineral was described by Lenz. It is of a grey colour spotted with dirty white, brownish red, brown and green: it is massive, but the surface is cellular and uneven; and both internally and externally it is glistening; the fracture is imperfectly conchoidal; it is opaque, hard, brittle, and difficultly frangible. Specific gravity 3.714. Analysis by Dobereiner, silex 32.5, protoxide of iron 32.0, protoxide of manganese 35.0. No locality is given.

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[*] Ice-spar from its possessing a considerable resemblance to ice, both externally, and in brittleness.

[†] After Major Von Knebel, who presented the mineral to Dobereiner.

KONILITE.[*]

Dr. MacCulloch.

It occurs in the form of a loose white powder, somewhat coarser than the silex obtained from silicated alkalies; it is gritty between the teeth, but not so hard as to scratch glass. Before the blow-pipe, it melts immediately into a transparent colourless bead, with apparently the same facility as glass. On attempting to analyse a very minute quantity, it was proved to consist chiefly of silex; a small quantity of lime was taken up by the muriatic acid, but its fusibility was not destroyed, which however was the case when treated with sulphuric acid. It does not effervese with acids; neither alkali, nor boracic acid, nor any trace of metallic matter was found in it. Dr. MacCulloch, the scientific discoverer of this mineral, however, observes that it is difficult to account for its great fusibility, unless it should contain the new alkali.

It is found in the valley of Glen Farg, and in the Isle of Mull, filling irregular cavities in amygdaloid, and is accompanied by analcime, mesotype, prehnite, and calcareous spar; and there was no appearance of decomposition in the accompanying minerals. It has since been found in the Isle of Sky, and in the Kilpatrick hills.

LIGURITE.[†]

Ligurit, Leonhard.

This mineral is described as occurring in oblique rhombic prisms of 140° and 40°, sometimes modified, of an apple green colour, and occasionally speckled externally. Its fragments are uneven and transparent, with a vitreous lustre. When powdered it is of a greyish white colour. Specific gravity 3.49. Analysis by Viviani, silex 57.45, alumine 7.36, lime 25.30, magnesia 2.56, oxide of iron, 3.00, oxide of manganese, 0.50. It is not electric either by heat or friction, and does not emit any phosphorescence on live coals.

It occurs in a sort of talcose rock, on the banks of the Stara in the Apennines.

According to Leonhard, it is considered as a gem in regard to colour, hardness, and transparency, and superior to the chrysolite.

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[*] Konilite, from the Greek, in allusion to its form of a powder.

[†] Ligurite, after Liguria, the country in which it is found.

LIMBILITE. Saussure.

It is described as being compact, and of a honey yellow colour. It scratches glass easily; and melts into a compact black enamel.

It occurred in the form of irregular grains in the volcanic hill of Limbourg.

MARGARITE.

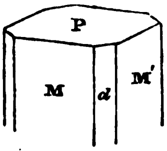
This mineral is in the mass of a greyish white colour, and occurs in very small crystalline laminæ, intersecting each other in every direction. The laminæ divide readily in one direction. It so very much resembles silvery mica, that it may be considered as doubtful whether it is only a variety of that substance.

It has lately been brought into the country from this Tyrol; it is accompanied by a green substance which appears to be chlorite.

MELILITE H. Bt.*

This mineral occurs in small square prisms, of which the lateral edges are mostly replaced. Internally the crystals are of a honey yellow or orange colour; externally they are usually coated by oxide of iron of a yellowish brown colour; they give sparks by the steel.

CXV
82



P on M or M' .. 90.°00'
M on M'....... 90. 00
M or M' on d ..135. 00

It has only been found at Capo di Bove near Rome, in the fissures of a compact black lava, with pseudo-sommite.

NECRONITE.

Dr. Hayden.

It occurs only in small masses, occasionally presenting some appearances of regular external form, and of a clear white, or bluish-white colour, and somewhat silky lustre externally. It is of about the same hardness as felspar, which it much re-

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[*] Melilite, from its being of a honey yellow.

sembles internally, and of which it may perhaps prove to be only a variety: like that mineral, it is mechanically divisible in two directions at right angles to each other, and presents some imperfect indications of cleavage in a direction oblique to the preceding. In the mass it is opaque, but when reduced to thin laminæ, it is translucent or transparent. It possesses a disagreeable odour:* it is said to be infusible alone, and not to have exhibited any change by exposure to the heat of a smith's furnace, and is not affected by acids.

It is found in primitive limestone, accompanied by brown mica, 21 miles from Baltimore in North America.

The limestone has been chiefly employed in Washington's monument.

OMPHACITE.

Omphacit, Werner.

This mineral occurs in masses composed of small crystalline filaments, of which the colour is green of various shades of intensity, most frequently a deep grass green. It is translucent, and in small fragments nearly transparent; it yields to mechanical division parallel to the sides of a rhombic prism, but not of sufficient regularity and brilliancy for the use of the reflective goniometer. It is supposed to be a variety of hornblende.

It is found with actynolite, with which it is often intermixed, and with garnet and mica, near Hoff in Baireuth, and in the Tyrol.

PICROLITE. Hausmann.

It is described as occurring massive, and of a green or yellow colour: its fracture is splintery, passing into flat conchoidal, sometimes the structure is fibrous: internally it is dull, or glimmering and pearly: it is translucent on the edges, brittle, has a meagre feel, and is infusible. It is said to be principally composed of carbonate of magnesia. No locality is given.

SPHÆRULITE.†

Sphærulit, Breithaupt.

It occurs in small roundish masses, sometimes aggregated in the botryoidal form: also it is said in fibrous concretions. The colour is brown of various shades. It possesses no regular cleavage, and the surfaces produced by fracture are dull or scarcely glimmering: it is nearly or quite opaque, even on

8.CLXI
83

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* Whence Necronite, from the Greek, in allusion to that quality.

† Sphærulit, doubtless from its occurring in spherical masses.

the edges, and of about the same hardness as quartz. Specific gravity, 2.50. It is infusible or nearly so, before the blow-pipe.

It occurs in pitchstone and pearlstone in Iceland, Saxony, and Scotland.

SIDERITE.

Bernhardi and Tromsdorff.

This mineral is compact, of a greyish or greenish blue colour, is nearly as hard as quartz, and possesses a resinous or
CXXXVI waxy lustre; it is translucent on the edges. It has sometimes
84 been confounded with the lazulite.

It occurs in the neighbourhood of Golling, near Salzburg, in granular gypsum; its surface is sometimes covered by a reddish yellow, or bluish earthy oxide of iron.

SIDEROCLEPTE. Saussure.

This substance is massive, translucent, of a yellowish green colour, and often yields to the nail; its lustre is weak and somewhat greasy. It is infusible under the blow-pipe, but becomes of a deep brilliant black.

It was found by Saussure in the cavities of the volcanic lava of Brisgaw, in the form of round or botryoidal masses, which sometimes appeared to consist of concentric coatings.

In some of its characters it nearly resembles the chlorophæite of Dr. MacCulloch.

SORDAWALITE.

Sordawalit, Nordenskiold, Leonhard.

This mineral is described as being nearly black, rarely grey or green, but as being sometimes by atmospherical action externally of a red colour. It is opaque, compact, and its fracture is conchoidal: it is harder than apatite, but is scratched by quartz, and its powder is of a grey colour. Specific gravity 2.58. Analysis by Nordenskiold, silex 49.40, alumine 18.17, magnesia, 10.67, protoxide of iron, 18.17, phosphoric acid 2.63. water 4.38.

It occurs forming a considerable bed on ordinary trap, and between it and clay, or clay ironstone (?) at Sordawala * in the government of Wibourg.

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* Whence Sordawalite.

THULITE.

A mineral has lately been brought from Tellemarken in Norway (?) under the name of Thulite; but no account of it has yet been made public in this country. It occurs in crystalline masses approaching in colour to a rose-red, and yielding to mechanical division parallel to the lateral planes of a rhombic prism of 87°.30′ & 92°.30′ by the reflective goniometer. It is not so hard as quartz, which scratches it, and it yields to the knife, though with some difficulty, affording a greyish white powder. It is sometimes involved in the same mass with transparent quartz, translucent and nearly colourless fluor, and greenish idocrase.

E. CLXV
8

WOLLASTONITE. Leman.

This substance occurs in the lava of Capo di Bove, near Rome, in small masses, externally of a brownish tinge, internally transparent and colourless, or of a flesh colour, highly crystalline, and yielding readily to mechanical division in the same directions, and affording the same measurements by the reflective goniometer, as those of tabular spar, of which it can scarcely be said to be a variety. It is therefore to be hoped that the name given by Leman to this substance, in honour of Dr. Wollaston, will be abandoned; and that we shall ere long find the designation of Wollastonite, in honour of one who has done much for almost every department of science, appropriated to some mineral of a less questionable nature; for this has in turn been supposed to be a new substance—a variety of felspar—of hornblende—of meionite—and finally, tabular spar.

E. CXX
8

ZEAGONITE. ABRAZITE.* GISMONDINE.

Zeagonit, Abrazite, Gismondin, Leonhard.

This substance occurs in semi-globular masses, and in crystals in the form of an octohedron with a square base, the edges of the base being sometimes replaced by planes. It is of a greyish white colour, occasionally with a tinge of blue, rarely of red. The substance here figured, and which was brought into this country under the name of zeagonite, is so soft as to yield to the pressure of the nail; but the zeagonite is described by Brieslak, as being hard enough to scratch glass; it is brittle, and the fracture is conchoidal. It varies from translucent to transparent. Analysis by Carpi, silex 41.4, lime 48.6, alumine 2.5, magnesia 1.5, oxide of iron 2.5. Before the blow-pipe it emits, according to Brieslak, a phosphorescent light, loses it lustre, and becomes friable without melting. By the action of acids it is reduced to a jelly without effervescence,

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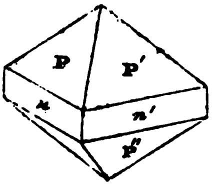
* Abrazite, in allusion to its not effervescing in acid, and becoming fusible before the blow-pipe without melting; Gismondine, in honor of Gismondi, who first noticed it.



P on P'........122°,58'

P' on P''....... 85 .40

It is found in the cavities of volcanic rocks, with calcareous spar, at Capo di Bove near Rome.

For the preceding figure and measurements, I am indebted to H. J. Brooke, Esq. but it seems needful to add, that a substance brought by Ashhurst Majendie, Esq. from Italy, under the name of zeagonite, with the above locality, and in the form of four octohedrons simply attached to each other, yielded by the reflective goniometer the measurement of 96°.30 P' on P''.

ZURLITE.*

Zurlit, Leonhard.

It is described as occurring in rectangular prisms, occasionally flattish, rough externally, and with convex surfaces; also in botryoidal masses: its fracture is said to be conchoidal, passing into uneven, internally compact, with a corneous texture: colour asparagus green; yields to quartz and to the knife, but emitting sparks by the steel. Specific gravity 3.274. Before the blow-pipe it is reducible with borax into a blackish glass,

Occurs on Mount Vesuvius with calcareous spar, and was discovered by Remondini.

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* According to Leonhard, in honour of Ritter Zurlow,

NATIVE METALS AND METALLIFEROUS MINERALS.

Including such Metals as are found nearly pure in the native *state ; or variously combined with other substances, forming* metalliferous *ores ; as, with other metals, with sulphur, with oxygen : also in the state of* oxides, *mineralized by acids ; beginning with the oldest and most universally diffused of the metals, Iron ;* (see Introduction.)

IRON.

The ores of Iron are numerous; but as the greater number of them have not been analysed, they are scarcely susceptible of a satisfactory arrangement.

NATIVE IRON.

Gediegen Eisen W. Fer natif H. Terrestrial native Iron J. Massive native Iron A.

It is described as being of a lighter colour than common iron; being either steel-grey, or of the colour of platina, with a metallic lustre; it appears to have been found massive, in thin plates, ramose and cellular; and opaque, hard, malleable, flexible, and magnetic. That of Kamsdorf in Saxony, consisted of iron 92.50, lead 6.0, copper 1.50: Klaproth.

It occurred in the form of a ramose stalactite covered by brown fibrous oxide of iron, mingled with quartz and clay, in a vein traversing the mountain of gneiss, called Oulle, near Grenoble in France. In a gangue of brown garnets, near Steinbach in Saxony. In a vein at Eibestock in Saxony. At Kamsdorf in Saxony, a mass of brown oxide of iron mingled with spathose iron and sulphate of barytes, contained native iron disseminated through it.

The two following substances are ranked with native iron.

Native Volcanic Iron (Fer natif volcanique H.) was discovered in a ravine formed by torrents across the lava and scoriæ of the mountain of Graveneire, in the department of Puy de Dome in France. It is also said that *pseudo-volcanic steel* (acier pseudo-volcanique H.), was found a league and a half from Neiss, in a place called la Bouiche, in the department of Allier, near a coal mine, which appeared to have taken fire spontaneously.

Native Meteoric Iron. Fer natif meteorique H. It is of a pale steel-grey, but is usually covered by what appears to be a coating of brown oxide of iron. It is commonly massive, CLXIII but is described as having been observed in the form of the octohedron. It has a metallic lustre, is flexible but not 87 elastic, is malleable, and very tough. Specific gravity 6.48—7.40. That of Siberia consists of metallic iron 98.5, nickel 1.5. That of Agram contains 3.5 of nickel: that of Mexico 3.25; most if not all of those which have been analysed contain that metal, and some of them chrome. Stromeyer detected the presence of cobalt in a specimen taken from the great mass at the Cape of Good Hope; but could not discover it in those of Siberia and Bohemia.

It has been found on different parts of the earth: but the only mass that is said to have been seen to fall from the atmosphere, is that which fell at Hraschina, near Agram in Croatia; it is described as having appeared in the air like a globe of fire. If this be authentic, there will be reason to conclude, from the great similarity in the constituents of the various masses found in different countries, that they have one common origin.

Of the mass found in Siberia, we have the best account. It was found by Professor Pallas on the top of a mountain, on which there was a considerable bed of magnetic ironstone, on the banks of the river Jenisei. It weighed 1680 Russian pounds, and possesses some of the important characters of pure iron, as malleability and flexibility, and was reported by the inhabitants to have fallen from the sky.

The mass found in the Vice-royalty of Peru in South America, was described by Don Rubin de Celis: it weighed about fifteen tons; it was compact externally, and was marked with impressions as if of hands and feet, but much larger, and of the claws of birds; internally it presented many cavities: it was nearly imbedded in white clay, and the country round it was quite flat and without water. It contains 10 per cent. of nickel. Lately, however, some reason has appeared for supposing that this mass was in fact only a part of a large and extensive vein of native iron; and if so, it is remarkable that it should contain so large a proportion of nickel.

A mass was found in the desert of Sahra in Africa. It yielded 4 per cent. of nickel. Other masses have been found in Africa, in Mexico and in North America. The latter was found near the Red River in Louisiana. It exceeds 3000 lbs. in weight, and is covered by a blackish crust. In its cavities were found crystals in the form of the octohedron, the largest of which is more than half an inch in length. It is very compact.

The masses of Siberia and South America above mentioned were not compact iron, but enclosed roundish masses of a greenish yellow semi-transparent substance resembling *olivin*. (See Meteoric Olivin.)

Iron has also been found entering into the composition of those stony masses which have been seen to fall from the atmosphere in various parts of the world, and even in our own country, termed *meteoric stones* or *aerolites*. For a well authenticated account of one which fell in the north of England, and which is now in the possession of J. Sowerby, Meade's-place, Lambeth; see his "British Mineralogy." Cl (316

ARSENICAL IRON. MISPICKEL.

Fer arsenical H. Bt.

It is nearly of a tin-white colour, sometimes with a tinge of yellow. It occurs massive, acicular, and crystallized in the form of a right rhombic prism, parallel to whose planes it may be cleaved, (to the lateral planes most readily), affording by the planes so produced angles of 111° 12′ and 68° 48′ by the reflective goniometer; this prism is considered to be the primary form of the crystals of mispickel, which exhibit about 40 varieties of form. The cross fracture is uneven, with a metallic lustre. It gives fire with the steel, and the sparks are attended with a little train of white smoke, having the odour of garlic. Specific gravity 5.6 to 6.50. It consists of iron 58.9, arsenic 42.1. Berzelius found more arsenic than iron. Before the blow-pipe on charcoal, it gives out a copious arsenical vapour, without destroying the form of the crystal, which afterwards attracts the magnetic needle.

CI. (3

DXLV (31

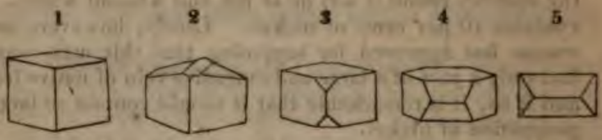
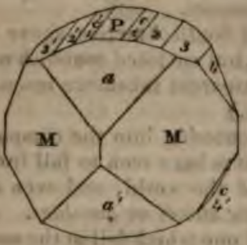


Fig. 1. The primary; a right rhombic prism. **Fig. 2**, the same, of which each terminal plane is in part replaced by two planes slightly inclining on the acute angles of the prism. Fig. 3 exhibits the primary prism modified by triangular planes replacing each obtuse solid angle: these planes are further advanced in fig. 4, and still further in fig. 5; having totally replaced the terminal planes, and reduced the lateral planes to triangles, meeting two and two at the acute edges of the prism.



M on M	111°12'	
P on M or M	90,00	
M on *a*	136,20	
— — c3	117. 2	
— — c4	116,10	
a on *a'*	121,52	
c1 on c'1 over P	154,56	H
c2 on c1' ———	142,00	*cg*
c3 on c3' ———	118, 5	
c4 on c4 ———	79,30	
c4 on c4'	100,30	

It chiefly occurs in the veins and beds of primitive mountains, and is associated with the ores contained in their veins. It occurs in Bohemia, Saxony, &c.

In Cornwall, with oxide of tin in many if not most of its mines; with the ores of copper; and occasionally imbedded in chlorite; as in Relistian mine.

Argentiferous Arsenical Iron. Weisserz W. Fer arsenical argentifère H. It is whiter than pure arsenical iron, being of a somewhat silvery white; but agrees with it in all its other characters, except that it contains silver in the proportion of 1 to 15 per cent. That of Andreasberg consists of 44 of iron, 35 of arsenic, 13 of silver, and 4 of antimony. Klaproth.

At Freyberg and Braunsdorf in Saxony, it is worked for the silver it contains.

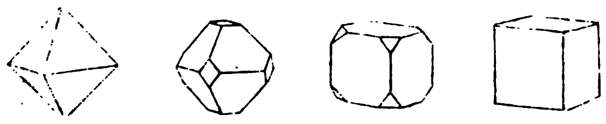
According to Brongniart, arsenical iron sometimes contains gold, and even cobalt in small proportion, without any sensible alteration of its external characters.

IRON PYRITES.*

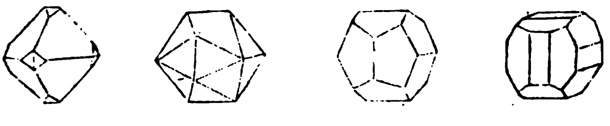
Schwefelkies W. Fer sulphuré H. Bt. Pyrite martiale Br.

Its ordinary colour is brass yellow, sometimes approaching to bronze-yellow, occasionally to steel-grey; it is often brownish or brown owing to decomposition. It occurs disseminated in rocks, veins, and beds, investing other minerals, and sometimes enclosed in them; also amorphous, mamillated, globular, cellular, stalactitical, pseudomorphous, capillary, and crystallized in the cube and octohedron, and in forms common to them both as primary crystals. It yields to mechanical division parallel to all the planes of the cube and regular octohedron, affording surfaces sufficiently brilliant for the use of the reflective goniometer; but with the greatest ease and brilliancy parallel to those of the cube, which has been adopted as the primary form; its cross fracture is granular or uneven, sometimes approaching the conchoidal; it is brittle, but does not yield to the knife, which serves at once to distinguish it from copper pyrites, which yields readily to it. Specific gravity 4.6—4.8. A crystallized specimen yielded to Hatchett, iron 47.85, sulphur 52.15. It gives sparks with the steel, sometimes with a sulphureous odour. Before the blow-pipe it melts, giving out the same odour, and leaving a blackish slag which is magnetic.

No difference in composition or cleavage has been found between those cubic crystals which are striated, and those which are not.



The 1st fig. the primary; the 2d the same, its solid angles replaced; the 3d more deeply, passing into the cube; 4th, the cube; 5th, the primary, each solid angle replaced by two planes; which are increased in fig. 6, and complete in fig. 7, and connected with the planes of the cube in fig. 8.



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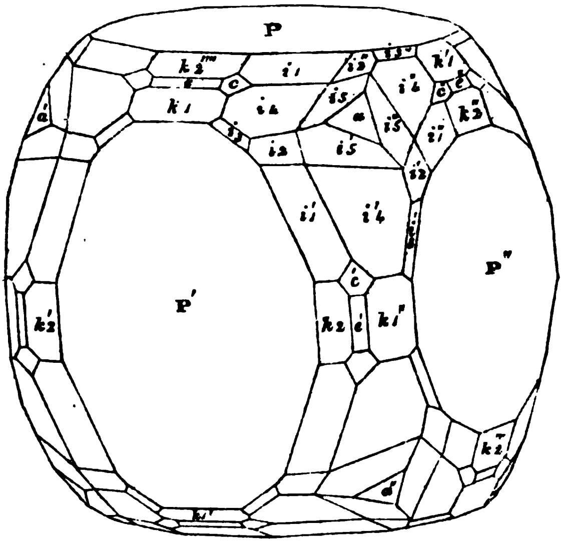
* Pyrites, from the Greek, in allusion to its giving sparks when struck.

XCIX (319)
CIV (320
XXX (321
XX/X (322
CCCLXXXII
(323
CCCLXXXI
(324
DXXVIII
(325
CCCCXXII
(326
CCCCXXXI
(327
CCCCLIV
(328
DXI (329)
CLXII (33
CCLXXXVI
(33
XXVIII (33
CCCLXVI
(3
CCCLXVII
(33
CCC (333
CV (336
CLXXI (33
CCCCLV
(33
CC (33
CCCLXXI
(34
CCCCLXXI
34



The above figure and the following measurements are given on the authorit
of Haüy.

P on P′ or P′	90°00′.00″.00‴
P P′ or P″ on *a*, P or P′ on *a*′, or P′ or P″ on *a*″	125.15.52.00
P or P′ on *e*, P′ or P″ on *e*′, or P or P″ on *e*″	135.00.00.00
P on *i* 1, P′ on *i* 1′, or P″ on *i* 1″	150.47.40.00
P on *i* 4, P′ on *i* 4′, or P″ on *i* 4″	143.18. 3.00
P on *k* 1′, P′ on *k* 1, or P″ on *k* 1″	146.18.38.00
P′ on *k* 2 or *k* 2′, P″ on *k* 2″ or *k* 2‴, or P on *k* 2⁗	153.26. 5.30
a on *a*′ or *a*″	109.28.16.00
a on *e*, *e*′, or *e*″	144.44. 8.00
— — *i* 5, *i* 5′ or *i* 5″	157.47.33.00
— — *i* 3, *i* 3′ or *i* 3″	164.12.24.00
— — *k* 2, *k* 2′ or *k* 2‴	140.46. 7.00
i 5 on *i* 5′, *i* 5′ on *i* 5″, *i* 5″ on *i* 5‴	146.26.33.00
i 4 on *i* 4′, *i* 4′ on *i* 4″, *i* 4″ on *i* 4	141.47.12.00
i 4 on *i* 1, *i* 4′ on *i* 1′, or, 14″ on *i* 1″	139.18.13.00
i 4, on *k* 2, *i* 4 on *k* 2⁗, or, *i* 4″ on *k* 2″	162.48.34.00
k 2 on *c*′, *k* 2″ on *c*″, or, *k* 2⁗ on *c*	169.19.46·00
k on *k* 2′, *k* 2″, or *k* 2‴	126.52.11.00

It is universally diffused.

Radiated Iron Pyrites. Fer sulfuré radié H. This occurs i masses of various forms, generally globular, with a fibrou structure : it appears to consist of small crystals radiatin from a centre ; the terminations of the crystals, which ar commonly octohedral, forming the surface of the mass, whic often is brown from decomposition: or the crystals are sometimes jagged on their edges (Fer sulfuré dentelé H), and disposed in a somewhat radiating form (*Cock's-comb pyrites.)*

Hepatic Pyrites. Fer sulfuré epigène. It occurs in many, if not most of the forms assumed by common pyrites. Externally it is of a liver-brown colour (whence its name); internally it is of a steel-grey, with more or less lustre, but is sometimes brown between the laminæ. Its colours appear to arise from the progress of decomposition, which, owing to some cause that has not been explained, proceeds often so far as to divest the substance of internal metallic lustre, without altering its form. In other varieties the form is destroyed by this process; the sulphur absorbs oxygen from the air, and passing into the state of sulphuric acid, combines with other substances, or with the iron of the pyrites, forming sulphate of iron; which often appears on the surface of the mass (which cracks and falls to pieces) in the form of white silky efflorescences. By this process the iron is often left in the state of red or brown oxide, frequently in the form of a powder.

Hepatic pyrites occurs in veins in primitive rocks, in most European countries, and in North America.

Arsenical Iron Pyrites. Fer sulfuré arsenicale H. It is of a paler yellow colour than common iron pyrites, passing, according to the proportion of arsenic contained in it, into steel-grey. When struck with the hammer, and also before the blow-pipe, it yields arsenical as well as sulphureous vapours. Sometimes it is magnetic.

It occurs with common pyrites, sometimes with arsenical cobalt.

Auriferous Iron Pyrites. Fer sulfuré aurifère H. It is of a deep yellow colour, and occurs in grains, also crystallized in the form of the cube, of which all the planes are deeply striated, and sometimes partially decomposed on the surface. The quantity of gold is but small, and appears to exist, according to the experiments of Bergmann, enclosed in the pyrites in the form of small angular grains, and therefore in the state of simple mixture.

It is found abundantly in the gold mine of Beresoff in Siberia.

Seleniferous Iron Pyrites. It is of a pale yellow colour, and occurs in granular masses, of which the crystalline particles possess but a slight degree of cohesion, and which

are externally more or less coated by brittle crystals in t
ordinary forms of iron pyrites.

It is found in Sweden, and in Bohemia; the above d
cription refers to the latter.

Pseudomorphous Iron Pyrites. Fer sulfure pseudomorphiqué
It occurs filling up the crevices of wood, and in the form
the interior of certain fossil remains, as of ammonites,

It occurs plentifully in the blue marle underlying t
chalk of England, as at Folkstone, and other places; a
also in others of the English strata.

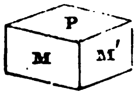
WHITE IRON PYRITES.

Strahlkies W. Fer sulfuré blanc H.

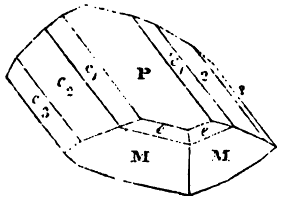
LV/ 88

Its name was derived from its colour, which is nearly t
white, sometimes with a tinge of yellow, more often of gr
It occurs stalactitical, reniform, botryoidal, and in crystals wh
are in the form of modified rhombic prisms, and of very
crystals, having at first sight the appearance of dodecahedr
with triangular planes, but which however are macles, consi
ing of similar portions of five crystals, connected as in the l
of the three following figures: the primary form is a ri
rhombic prism of about 106°. & 73°, parallel to the planes
which it yields to mechanical division. It consists accordi
to Hatchett, of more sulphur and less iron than common pyrit
One specimen yielded 45.56 of iron and 54.34 of sulph
according to the opinion of Berzelius it does not differ fr
common pyrites in composition, as might have been expect
from the striking difference between the primary form of t
mineral and that of common pyrites.

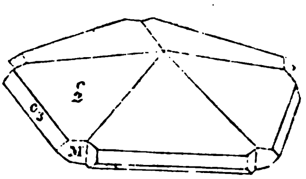
Primary.



M on M	106°. 2'
P on M or M	90 .00
—— c1	161 .24
—— c2	160 .48
—— c3	130 .00
M on *b*	158 .42
*c*2 on *c*3	141 .30



Macle.

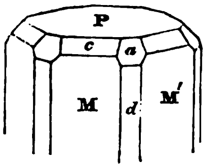


It occurs with common pyrites, in Cornwall, &c.

MAGNETIC IRON PYRITES.

Magnetkies W. Fer sulfuré ferrifère H.

It is of a yellowish white, reddish, or brownish, and loses its ıstre by exposure to the air. It occurs massive, and it is said, lso crystallized; the Comte de Bournon describes it as occurng in irregular six-sided prisms variously modified; the cleaage being parallel to the terminal planes of the prism. The CCLVII ıassive (of Bavaria) is sometimes of a lamellar structure, yield- (342) ıg to cleavage parallel to all the planes of a regular six-sided rism, the cross-facture is uneven passing into imperfectly ɔnchoidal. It affects the magnetic needle. It contains less ılphur and more iron than common pyrites and even than hite pyrites; affording according to Hatchett 63.5 of iron ıd 36.5 of sulphur. In the estimation of Haüy it contains ›me iron which is not combined with sulphur, to which its ıagnetic properties may be owing; and in the opinion of .atchett, iron combined with less than 37 per cent. of oxygen, ıay not only affect the needle, but may also receive and retain .agnetic properties.



M on M′	120°.00′
P on M or M′	90 .00
M or M′ on d........	150 .00
P on a	135 .00
—— c	102 .13

The above figure and measurements are given on the authority of the 'omte de Bournon.

It is found in Norway, the Hirtz, Silesia, and other Euro›ean countries, and in Siberia.

In Scotland, in some of the hills of Galloway, and Aphin in ırgyleshire, and in Wales at the base of Moel Elion in Caer:arvonshire; also it is said in Cornwall.

OXYDULATED IRON. LIV (343)

Magneteisenstein W. Fer oxydulé H. Bt. Fer magnetique commun Br. Magnetic Iron ore J. A. CXCVII (344)

It occurs earthy, compact, lamelliform, and crystallized in ıe regular octohedron, which is considered to be its primary CCLXIII ›rm, and in some of its varieties; its structure is imperfectly (345) mellar parallel to the planes of the octohedron; the fracture uneven, or conchoidal with a shining lustre; its colour is iron black, with a shining or glimmering metallic lustre. Its specific gravity is 4.4. It consists according to Berzelius of 28.14 protoxide of iron, and 71.86 of peroxide of iron. It is highly magnetic, with polarity, especially the massive (*Native Loadstone*). Before the blow-pipe it becomes brown, but does not melt.

LXXV
(346)
LXIV
(347)

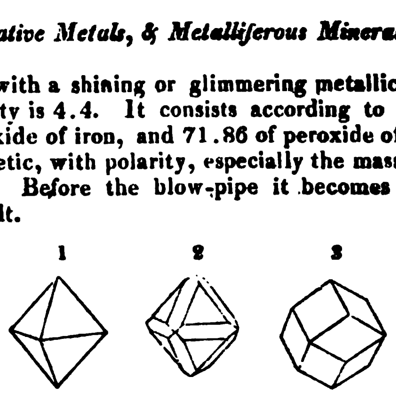
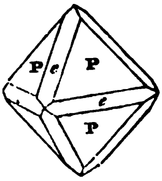


Fig. 1. The primary; the regular octohedron. Fig. 2. The same, of which all the edges are replaced by planes; this replacement has proceeded further, and the planes are complete in Fig. 3, the rhombic dodecahedron.



P on P	109°.28′.16″	H
P on e or P on e	144 .44 . 8	..
e on e	120 .00 .00	..

It is most commonly found in primitive countries, generally in beds and large masses; and is accompanied by hornblende, granular limestone, and garnet; and occasionally by blende, all the varieties of pyrites, fluate of lime, oxide of tin, and sulphuret of lead, &c.

The mountains called Taberg in Swedish Lapland, and Tumachanche in Chili, are said to consist almost entirely of oxydulated iron. It is plentifully found also in Corsica, Savoy, Saxony, Bohemia, Silesia, Russia, and the East Indies. In North America, in beds in granitic mountains, with little interruption from Canada to New York, and in many other tracts.

It exists in great abundance and purity in Roslagia in Sweden, where it is manufactured into the best bar iron, so much sought after by our manufacturers of steel, though it affords only middling cast iron. The most highly magnetic, that is to say, that in which the action of the two poles is strongest occurs in considerable masses in Sweden, Norway, China, &c

In Scotland, it occurs in serpentine in Unst, one of the Shetland Isles. In England, in the parishes of St. Roach an

t. Stephens, and at Treliswell near Penryn in Cornwall: crys-llized in octohedrons near Tavistock in Devon. In Ireland, ccompanying native gold in alluvium, and in granite, in Wick-w.

arthly Oxydulated Iron. Fer oxydulé fuligineux H. Earthy Magnetic iron ore J. It occurs massive, of a bluish black colour, and is dull, soft, opaque, and gives out the argillaceous odour, when breathed on. It is supposed to be a variety of massive oxydulated iron ore in a state of decomposition. It is found in the mines of Arendahl, and in that of Eiserfeld in Siegen.

itaniferous Oxydulated Iron. Fer oxydulé titanifère H. Iron sand J. Sandy Magnetic iron-ore A. It occurs in rounded and angular grains, and in small octohedral crystals of an iron-black colour and glimmering lustre externally; internally of a brilliant metallic lustre; the fracture is conchoidal: it is brittle, and yields to the knife. Specific gravity 4.6——4.9. It consists of oxide of iron 85.50, oxide of titanium 14.0, manganese 0.50, Klaproth. It is very magnetic. Berzelius is said to have found titanium in the iron ore of Elba. Alone before the blowpipe it is unalterable.

It is found imbedded in rocks, but more commonly in the sands of rivers and the sea-coast.

It occurs in porphyry in Bohemia, and in chlorite-slate at Westhaven in Connecticut, North America. In the form of loose sand in Meissen in Saxony, with hyacinth, iserine, nigrine, &c.; on the banks of the Elbe; at Treblitz and Posedlitz in Bohemia, with rolled pieces of basalt, sapphire, and hyacinth; at Puzzoli near Naples, with pumice, lava, &c.; in Puy de Dome, in France, with hyacinth, *(Volcanic sand)*; also in Corsica, and many other places.

In England; in a diallage rock near Gwendra, on the southern coast of Cornwall; and at Hunstanton in Norfolk. Magnetic iron sand, mixed with iserine, oozes, after heavy rains, from a coherent sand lying beneath a bank of clay on the shore of the Mersey opposite to Liverpool, and may be traced for several miles along the coast. In Scotland, in trap rocks in Fifeshire; in the river Dee in Aberdeenshire; in Argyleshire; the Isle of Sky. In Ireland at Arklow near Wicklow in alluvium with native gold.

hromiferous Oxydulated Iron. A substance consisting of 98 of protoxide of iron and 2 of chrome, and which has therefore been termed *Chromiron*, has been found in the sand of the river Rhine: it is accompanied by particles of quartz, iron-stone, mica, and argentiferous gold.

SPECULAR* IRON.

Eisenglanz W. Fer oligiste * H. Bt. Fer speculaire Br. Iron glance J.
Var. of red Iron ore A.

It is considerably magnetic, especially the highly crystalline, but does not, like oxydulated iron, attract iron filings. It occurs lamelliform, and crystallized in many forms which are derived from a slightly acute rhomboid of 86° 10′ and 93° 50′, by the reflective goniometer from planes produced by mechan-
XVIII ical division, the structure of the crystallised being lamellar,
(348) and reducible into the form of its primary crystal; its cross fracture is uneven, passing into the conchoidal. It is of a
LVI deep steel-grey colour, with a brilliant, and often irridescent tarnish externally; internally it possesses a brilliant lustre.
(349) It is opaque in large fragments, but the edges of small thin ones, are of a blood red colour by transmitted light. According to Hassenfratz, 100 parts consist of 69 of iron and 31 of oxygen. It is said that Berzelius found titanium in the iron-ore of Elba. Specific gravity 5. It is infusible without addition.

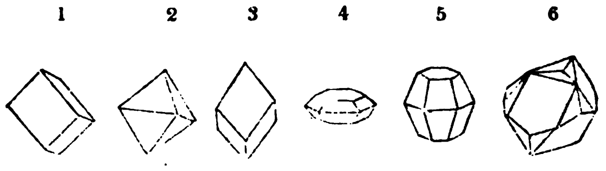


Fig. 1. The primary; a slightly acute rhomboid. Fig. 2, an octohedron, arising from the replacement of the upper and lower acute angles of the primary, producing the upper of the two planes next to us, and the lower plane of the other side of the crystal, not visible in the drawing. Fig. 3, an acute rhomboid, of which only the upper plane, and that parallel with it, correspond with the planes of the primary. The upper and lower lateral planes of fig. 4 belong alternately to the primary. In fig. 5 none of the primary planes are visible. Of fig. 6 all the larger planes belong to the primary, and the small triangular planes result from the replacement of its lateral and lower angles by two planes, and the upper acute angle by three planes. Sometimes the edges and angles are so rounded that the crystals assume a lenticular form.

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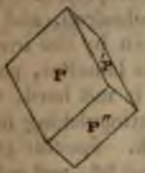
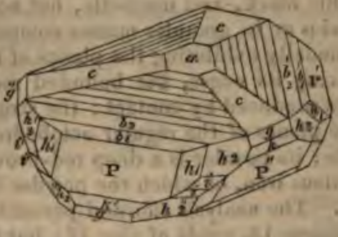
* Specular, from its brilliancy: Oligiste, from the Greek, in allusion to its containing only a small portion of metal.

The crystals of this substance, however, and especially those from Elba, most commonly occur in the general form of the second of the two following figures.

Primary.





P on P′	86°10′	P on *h*2 or *h*2′	154°20′
P on P″	93.50	—— *k*′ or P″ on *k*	147.20
P or P′ on *a*	122.40	*a* on *c*	168.30
————— *b*1	178.50	*h*2 on *h*2 or *h*2″ on *h*2″	128.32
————— *b*2	159.35	*h*2 on *i* or *h*2″ on *i*	161.40
P on *g*′ or P′ on *g*	140. 0	*i* on *i*	159.12
P on *h*1 or *h*1′	179.30	*h*2 on *g* or *h*2″ on *g*′	144.20

It occurs in transition and primitive rocks, both in beds and veins, and is accompanied by oxydulated iron, &c.

The mines of this substance in the isle of Elba are of great extent, and are said to have been worked upwards of 3000 years: it also occurs in Saxony, Bavaria, &c.; in Bohemia in beds of mica-slate; at the foot of Great St. Bernard: in Maryland, North America, in gneiss, and in chlorite: also in South America, and in Siberia.

In England, it occurs finely crystallized in St. Just, and in Tin Croft mine in Cornwall in killas; also in Lancashire. In Scotland at Cumberhead, in Lanarkshire, with red and brown iron-stone. The *lamelliform* is found in Eskdale in Cumberland.

Volcanic. It occurs in very flat crystals, often with curvilinear faces, and intersecting each other at various angles.

It occurs in the fissures of the lava of Auvergne in France, LXIV
in that of Vesuvius, of Stromboli, and in the Lipari islands. /35

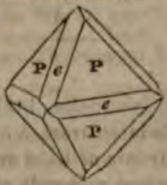
Micaceous. It occurs in minute shining scales, either loose or CCCCLXV
slightly cohering; by reflected light it is iron-black, sometimes with a tinge of red; by transmitted light, blood red. /35

It occurs near Tavistock in Devonshire, and near Dunkeld in Perthshire.

FRANKLINITE.*

Franklinite, Berthier.

This mineral considerably resembles oxidulous iron. It is metallic black, and magnetic, but not with polarity: it occurs in grains or in granular masses composed of imperfect crystals, occasionally exhibiting the planes of the octohedron, and those replacing its edges, but bounded more often by the irregular planes produced by contact; the structure is lamellar, parallel to the planes of the regular octohedron; it is not hard, and is brittle; its powder is a deep red-brown, distinguishing it from oxidulous iron, of which the powder is black. Specific gravity 4.87. The analysis afforded peroxide of iron 66, red oxide of manganese 16, oxide of zinc 17: but it is observed by Berthier, who analysed this mineral, that, as it attracts the magnetic needle, the iron cannot be in it in a state of peroxide, but is probably oxidated in the second degree.



P on P′ or P″ 109°25′

P on e or e .. 144.40

When this was about to be committed to the press, I received from my friend Dr. Seybert of Philadelphia, among other minerals, a specimen of this substance, which afforded crystals exhibiting the planes of the above figure; the measurements by the reflective goniometer prove the regular octohedron to be the primary form.

It occurs in New Jersey accompanying the red oxide of zinc, and is frequently imbedded in calcareous spar, and associated with quartz, yellowish green garnet and other substances.

HYDROUS OXIDE OF IRON.

DL (352) Fer hydro-oxidé, Bournon.

This mineral has often been mistaken for an ore of manganese. It is found both massive and crystallized: the structure of the DX (353) massive is generally fibrous and radiating, the fibres being sometimes regularly terminated on the surface of the mass, but frequently the crystalline terminations are so minute as to give a D (354) velvety appearance to it. The crystals are very small, externally black and very brilliant, internally blackish brown, which also is the colour of the massive when broken: the powder is yellow; and it is very brittle and opaque; it also occurs in extremely tender stalactites, of which the fibres radiate from the centre to the circumference. The form of the primary crystal appears to be a right rectangular prism, the only cleavage being parallel to the plane M. It is not so hard as hæmatites iron, but scratches glass. That of Bristol has not been analysed, but a specimen found in France, departement du Bas Rhin, analysed by Vauquelin, afforded oxide of iron 80.25, water 15, silex 3.75.

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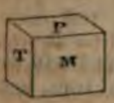
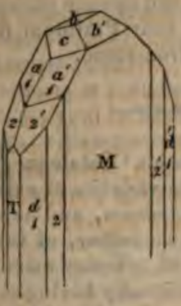
* Franklinite in honour of the celebrated Franklin.

Primary.





P on M or T	90.00′
T on M	90.00
M on *a*2′	135. 5
— — *b*′	121.45
— — *d*1	117.50
*a*1 — *a*′1	125.30
*a*2 — *a*2′	149.24
b — *b*′	117.30
c — *d*1	120.42
c — *b* or *b*′	135.20
b — *a*2 or *b*′ or *a*2′	121.25
*a*1 — *d*1	129.30
*a*2 — *d*1	153.25
*d*1 — *d*1 over T	130.40
*a*2 or *a*2′ on c	147.00

The second of the above figures represents some crystals from near Bristol.

It occurs at Clifton near Bristol in quartzose geodes, in the form of mamillary masses, and often enclosed in quartz crystals: on compact hard iron-stone near Botallack, Cornwall; it also occurs in Siberia: in France in the departement du Bas Rhin.

1. STILPNOSIDERITE.*

Ullmann.

It is described as occurring in oblique quadrangular prisms, massive and dendritic; as being of a black or brownish black colour, with a splendent lustre both externally and internally; fracture conchoidal; opaque, brittle. Specific gravity 3.7. Analysis—oxide of iron 80.50, water 16.0, silex 2.25.

It is said to occur in Saxony and Bavaria with brown hæmatites iron ore.

2. CRONSTEDITE.†

Cronstedit, Schweigger's Journal; Leonhard.

This mineral is described by Leonhard as occurring both massive and crystallized; the massive as consisting of black and opaque fibres, having a brilliant lustre; the crystallized as occurring occasionally in separate six-sided prisms, more often however the prisms adhere laterally. It may be scratched by calcareous spar, and in thin laminæ is somewhat elastic; reduced to powder, it is of a leek-green colour. Specific gravity 3.348. Analysis, oxide of iron 58.85, oxide of manganese 2.88, magnesia 5.07, water 10.70, silex 22.45. Before the blowpipe it intumesces, but does not melt: with borax it affords with difficulty a hard, black, and opaque enamel.

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* From the Greek, signifying a shining ore of iron.

† In honour of Cronsted, the Swedish mineralogist.

It is found at Albertigang near Przibram in Bohemia with carbonate of iron and brown iron-stone.

◆

The Comte de Bournon, in his 'Catalogue,' appears to have included most of the following varieties of oxide of iron, under the term of *Fer oxydé au maximum*, and he thus describes it generally.—It is of a red-brown colour, of various shades, but in proportion to the strength of cohesion among its particles, it approaches a steel-grey, occasionally having the lustre of steel. LXXIX (355) The pulverulent varieties are considerably red. It occurs in cubes, sometimes perfect, sometimes modified on the edges, and in extremely thin tabular crystals: also in fine-grained masses of a steel-grey colour; scaly, and micaceous; also baccillary, scopiform, and pulverulent. Its hardest varieties are not so hard as specular iron. Its fracture is conchoidal. The specific gravity of the cubic crystals is 3.96. Its powder is of a deeper red than that of specular iron. In its pure state it does not affect the magnetic needle; but it sometimes happens that particles of an inferior degree of oxidation are enveloped in it, giving rise to a slight action on the needle. It is found among the iron ores of Jellivara in Swedish Lapland, often in considerable masses, mingled with oxydulated iron. The varieties of micaceous iron, which do not affect the magnetic needle, belong to the *Fer oxydé au maximum*.

Berzelius inclines to the opinion that the red and brown iron ores are hydrates of iron, since in the matrass they give off water, leaving a red oxide of iron.

RED IRON ORE.

Rother Eisenstein W. Red Iron-stone J.

Some of the varieties, as the more compact hæmatites, sometimes affect the magnet in a very slight, though in a perceptible degree, rendering it probable that they contain a small portion of the protoxide of iron. None of them, like some of the foregoing, are blood-red by transmitted light; they are much softer, and rarely assume a crystalline form. They are infusible without addition; with borax give a dirty green glass.

*Fibrous Red Iron Ore. Red Hæmatite.** Rother glaskopf W. Fer oligiste concretionné H. Externally its colour is mostly bluish or iron-grey, with a slight or considerable metallic lustre, sometimes red and without lustre; internally it is DXVI (35 red or brownish-red; the structure is fibrous, often radiating, and without lustre: in the other direction the structure is concentric lamellar. It mostly occurs in round, or botryoidal masses, or in stalactites. Specific gravity 4.7—5. LVI (35 A specimen analysed by Daubuisson, yielded 90 per cent. oxide of iron, with a trace of manganese, 2 of silex, 1 of lime, and 3 of water. CXIV (35

It is found in beds and veins in primitive and secondary mountains.

It occurs abundantly in Saxony; also in Bohemia, in the Palatinate, Silesia, and many other European countries.

In England, it occurs in Ulverstone in Lancashire, in Cumberland, in Devonshire, and also it is said in the forest of Dean in Gloucestershire. In Scotland in veins in sandstone in Lanarkshire; in flœtz greenstone at Salisbury Craigs near Edinburgh.

It affords excellent iron both cast and malleable; most of the plate iron and iron wire of England are made of it. When ground to fine powder, it is largely employed in the polishing of metal. In Scotland it is used along with the ore of that country at Carron and Glasgow works.

Compact Red Iron Ore. Dichter Rotheisenstein W. Fer oxidé rouge compact Bt. Fer oligiste compact H. It occurs massive, slaty, and in crystals in the form of the cube, either perfect, or with the angles replaced, which are supposed to be *pseudomorphous*. It is of an iron-grey colour, with a shining lustre, or brownish-red with a glimmering lustre; internally it is more or less glistening; the fracture is either even, granular uneven, or flat conchoidal; when reduced to powder, it is of a blood-red colour: it yields to the knife. Specific gravity 3.5—5.

It occurs in primitive and secondary rocks, associated with red hæmatite, &c. and is found in the Hartz, in Hesse, in Saxony, Bohemia, Spain, and France.

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allusion to its blood-red colour. Now,
term is so far lost sight of, that we

In England, at Ulverstone in Lancashire; it occurs in an enormously thick vein traversing limestone.

It affords good cast-iron, and malleable though somewhat soft, bar-iron.

Scaly Red Iron Ore. Rother Eisenrahm W. Fer oxidé rouge luisant Bt. It occurs in slightly cohering scales or particles of a red colour with a tinge of brown, and opaque; the lustre is somewhat metallic. It is unctuous to the touch and stains the fingers. It is infusible without addition.

According to Henry, it consists of iron 66, oxygen 28.50, silex 4.25, alumine 1.25.

It occurs with the preceding varieties, sometimes coating
CCLIII them, and with magnetic ores in various parts of the Euro-
(359) pean Continent.

In England, at Ulverstone.

CLIV (360) *Red Ochre.* Ochriger rotheisenstein W. Fer oxidé rouge
ochreux Bt. It is of a light blood-red colour, sometimes
CLV (361) with a tinge of brown: and consists of faintly glimmering,
minute particles, often coating the other varieties, but
which sometimes cohere and become massive. It has a
CLVI (362) meagre feel, gives a blood-red streak, and more or less
stains the fingers.

It occurs with the preceding varieties.

Red Chalk. *Reddle.* It is of a brick-red, or brownish-red colour. It occurs massive, with an earthy fracture, and is dull, opaque, soft, meagre to the touch, stains the fingers, writes easily, and adheres to the tongue; specific gravity 3.3—3.8.

It occurs in small masses in clay-slate; also in sandstone and limestone: and is found in Hesse, Thuringia, Lusace, Silesia, Salsburg, and in Siberia.

It is found in St. Just in Cornwall.

BROWN IRON ORE.

Brauneisenstein W. Fer oxidé H.

As the red iron ore has not been analysed, it is impossible to say wherein this differs from it in respect of composition. It is described as occurring crystallized. When reduced to powder, it is of a blackish-brown colour; it blackens and becomes magnetic before the blow-pipe, but is infusible without addition; it tinges borax olive green. It gives a yellowish-brown streak, when rubbed on paper.

Crystallized Brown Iron Ore. It is said to occur in the form of the cube, sometimes with the edges and angles replaced, brown externally, internally compact, of a bluish grey colour and glimmering lustre. It may be doubted whether some crystals do not belong to the hepatic variety of iron pyrites, and whether others are not pseudomorphous: CCCCXXX when heated it is said to become magnetic. (36

Fibrous Brown Iron Ore. Brown Hæmatite. Brauner Glaskopf W. Fer oxidé hæmatite H. It is of a clove-brown, LX (364 or blackish-brown; externally it is often of a steel-grey colour, and splendent; it is more finely fibrous than the red oxide, sometimes with a silky lustre, and often radiated; CXIII(36 in the other direction it is generally concentric lamellar, and the colours are often disposed in concentric bands of brown of various shades. It occurs in mamillary CXXXII and botryoidal masses, and in stalactites and tubes. It is (366 brittle: specific gravity 3.7—4. It consists of peroxide of iron 80.25, water 15, silex 3.75. Vauquelin: but Daubuisson in two analyses, found 2 per cent. of oxide of manganese.

It occurs in beds in limestone and some other secondary rocks in most European countries; affording materials for very large iron works in Bohemia and Saxony, &c. &c. Sweden and Lapland, which abound in magnetic iron ores, contain but small quantities of the brown or red ores.

In Scotland in veins in sandstone at Cumberhead in Lanarkshire, and in Mainland, one of the Shetland Isles, and in Hoy, one of the Orkneys. In Cornwall at Botallack mine, near the Land's End, and in Tin Croft mine, near Redruth.

It affords a very malleable and much harder iron than the red ore, and very good steel.

Compact Brown Iron Ore. Dichter brauneisenstein W. It occurs massive and cellular, sometimes with an irridescent tarnish superficially: also in the form of the madrepore and fungus. Its fracture is uneven, or flat-conchoidal, with a glimmering metallic lustre: it yields pretty easily to the knife. Specific gravity 3.5—3.7. It consists of 84 peroxide of iron, 11 of water, 3 of oxide of manganese, 2 of silex, and 3 of alumine.

Its localities are nearly the same as the foregoing variety, which it often accompanies.

Scaly Brown Iron Ore. Brauner Eisenrahm W. It occurs in the form of shining scales, with a somewhat metallic lustre and of a colour between clove-brown and steel-grey: these particles are either loose or cohere slightly, or are aggregated into dendritic forms. It stains very much, and is unctuous to the touch.

It mostly occurs in the cavities of the fibrous variety.

Ochery Brown Iron Ore. Ockricher brauneisenstein W. Fer oxidé pulverulent H. It consists of small particles which are loose, or cohere but slightly. It is of a pale brown colour, tinged more or less with yellow, and is soft and stains the fingers.

It occurs in Norway, Saxony, Bohemia, and other European countries.

In Oxfordshire at Shotover hill, and in Cornwall it sometimes abounds in the copper veins, as in that of the Muttrel mine, in which the red oxide of copper was found. There is reason for concluding that it may sometimes arise from the decomposition of pyrites.

Umber. It is of a clove-brown, blackish or yellowish brown: it is massive, with an earthy, or sometimes conchoidal fracture, and glimmering or resinous lustre. It is soft, stains very much; is meagre to the touch, adheres strongly to the tongue, and falls to pieces in water. Specific gravity 2.06.

It consists of oxide of iron 48, oxide of manganese 20, silex 13, alumine 5, water 14.

It occurs in beds in the isle of Cyprus, and is used as a pigment.

BLACK IRON ORE.

Schwarz Eisenstein W. Mine de fer noir Br.

Of this there are three varieties, which have not been analysed, but are supposed to contain more manganese than brown iron-ore.

Fibrous Black Iron Ore, Black Hæmatite. It is of a bluish black colour, passing into steel-grey, and occurs reniform and globular: the structure is finely fibrous and divergent, with a glimmering, imperfect metallic lustre. It gives a shining streak on paper, yields with some difficulty to the knife, is opaque and brittle. Specific gravity 4.7. It is infusible without addition, but affords a violet glass with borax.

ompact Black Iron-Ore. This differs from the fibrous, in possessing a conchoidal, or fine-grained and uneven fracture. It occurs massive, and in distinct concretions consisting of concentric lamellæ which are somewhat curved.

Both the above varieties are found in small quantity in comparison of the red and brown ores. They occur in veins in primitive and secondary mountains, accompanying brown iron-stone, in several places in the Saxon Erzgebirge and the Hartz, but more frequently in Thuringia and Westphalia.

It affords a good iron, which acts very powerfully on the furnace.

chery Black Iron-Ore is said to occur in St. Just, in Cornwall, but no description of its characters has been given.

isiform Clay Iron-Stone. Pea Iron Ore. Bohnerz W. Fer oxidé globuliforme H. Fer pisiform Br. It occurs in small globular or spheroidal masses, of a yellowish or blackish brown colour; the fracture is sometimes even, sometimes earthy. It consists of oxide of iron 48, alumine 31, silex 15, water 6: but Klaproth and Daubuisson found more iron, and a small proportion of oxide of manganese.

It occurs imbedded in secondary limestone, and in a rock of a calcareous basis.

It occurs abundantly in several districts of France: in the Jura mountains, in a large bed resting on the Jura limestone, and in several other parts of Switzerland, and in Franconia and Suabia.

In Scotland in the Upper district of Ayrshire.

It supplies considerable iron works in France and Switzerland; but the iron is said to be of bad quality and brittle.

JASPERY IRON-ORE.

Jaspisartiger Thoneisenstein W. Jaspery Clay Iron-stone J.

It is of a reddish or yellowish brown colour, and occurs mas- ve. The fracture is flat conchoidal, passing into even, with a limmering lustre. It is hard, opaque, and yields to the knife, it with difficulty. It blackens and becomes magnetic before te blow-pipe.

It occurs in Wienerish-Neustadst in beds resting on transition limestone, and covered with sandstone belonging to the coal formation.

In England it is found at Billingsley in Shropshire; in Cornwall, not far from Botallack near the Land's End, intermixed with jasper of a yellow colour.

BOG IRON-ORE.*

Raseneisenstein W.

It is considered to be of very recent formation, and it is divided into three varieties.

Friable Bog Iron-Ore. Morasterz W. Mine des Marais Br. Bt. It occurs in friable masses, consisting of dull minute particles of a brown yellowish colour; sometimes it is tuberous: the fracture is earthy.

Indurated Bog Iron-Ore. Sumpferz W. La Mine des lieux bourbeux Br. Bt. It occurs amorphous, and is sometimes vesicular. It is of a dark yellowish brown or grey: the fracture is earthy, or fine-grained, with a glimmering lustre, or it is dull: it is very soft.

Compact Bog Iron-Ore. Weisenerz W. La mine des prairies Br. Bt. Conchoidal Bog Iron-ore J. It occurs amorphous, tuberous, and in roundish grains of a blackish brown colour: the fracture is imperfect and small conchoidal, passing into fine-grained uneven, with a glistening or resinous lustre. It consists of oxide of iron 66, oxide of manganese 1.50, phosphoric acid 8, water 23. Klaproth.

In the opinion of Werner, as detailed by Jameson, the varieties of Bog Iron-ore arise from the decomposition of the rocks over which water passes, and are deposited by the water when in a state of rest in bogs and marshy places. The first variety is supposed to be the newest; the second to arise from the first by partial exposure to the action of the air; and the third from the second, after the more complete evaporation of the water.

It is found at Torgau in Saxony, in Lusace; in Hanover, Prussia, Poland, Russia, Sweden, &c.

In Scotland, in several places in the Highlands, also in the Hebrides, Orkney, and Shetland islands.

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* So named from its being chiefly found in marshy places.

In England, at the bottom of the morasses of the Cheviot hills.

The iron obtained from Bog Iron-ore is what is termed cold-short, and therefore can rarely be used for plate-iron, never for wire.

PITCHY IRON-ORE.*

E. LIII
89

Eisenpecherz W. Fer oxydé resinite H.

It is of a blackish brown, or greyish black colour; it occurs in small masses: the fracture is flat conchoidal or fine-grained, with a shining or glistening lustre. It is translucent on the edges, and yields to the knife. It gives a lemon-yellow coloured streak. Specific gravity 2.4. It consists of oxide of iron 67, sulphuric acid 8, water 25. Klaproth. The Comte de Bournon in his 'Catalogue' describes a pitchy Iron-ore (Fer oxidé piciforme) as occurring in rectangular prisms, either perfect, or with two opposite angles replaced so as to convert the prism into an octohedron.

It was formerly found in a mine near Freyberg in Saxony; more lately in the district of Pless in Upper Silesia, and in Brittany.

PYROSMALITE.

Pyrosmalith, Karsten. Fer muriaté, Lucas. Pyrosmalite, or Native Muriate of Iron J.

E. LXXX
90

It is of a liver-brown, or pistachio-green colour, and is said to occur in six-sided prisms, or tables, of which the terminal edges are sometimes replaced. Externally the lustre is shining, that of the terminal planes is pearly. The structure is lamellar, with a shining pearly lustre: the cross fracture is glimmering. It is translucent on the edges, somewhat hard, and brittle. Specific gravity 3.081. Analysis by Hisinger; protoxide of iron 21.810, protoxide of manganese 21.140, submuriate of iron 14.095, silex 35.850, lime 1.210, water and loss 5.895. On charcoal before the blow-pipe with a gentle heat it gives out a weak acid odour, fusing readily into a globule with a brilliant smooth surface and iron-grey colour.

It occurs in a bed of magnetic iron-stone, with calcareous spar and hornblende in Bjelke's mine in Nordmark near Philipstadt in Sweden.

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* From its more or less perfect resemblance to pitch.

SPATHOSE IRON. CARBONATE OF IRON. BROWN SPAR.*

CCXVI

(367) Spath Eisenstein W. Fer oxydé carbonaté H. Fer spathique Br. Bt.

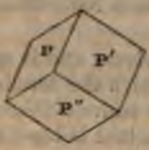
It occurs of a wine yellow, brownish yellow, yellowish brown and brown colour, and brownish black by decomposition; and is either transparent, translucent, or opaque. It is found in obtuse rhomboids (the faces of which are sometimes, but not often, curvilinear); in acute rhomboids, sometimes perfect, or having the terminal angles replaced; in six-sided prisms, in octohedrons, and in lenticular crystals; also striated and massive. Externally it is shining. The structure is lamellar with a brilliant lustre; it readily yields to mechanical cleavage parallel with all the planes of an obtuse rhomboid of 107° and 73°. It yields easily to the knife, affects the magnetic needle, and before the blow-pipe it blackens and becomes more magnetic. Specific gravity 3.6—3.8. A specimen analysed by Bayen yielded iron 66, carbonic acid 34. By other analyses, it appears that this substance often includes small proportions of lime, magnesia, and oxide of manganese; indeed the precise limits between this substance and pearl spar are by no means defined. Carbonate of iron blackens before the blow-pipe with a very gentle heat, leaving protoxide of iron very attractable by the magnet.

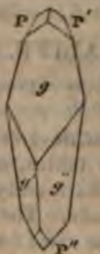
XII (368)

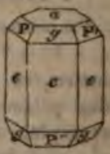
XVII (369)

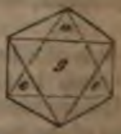
XII (370)

XIII (371)









P on P'	107°00'	P or P' on a (fig. 3)	140°00' c. g.
P or P' on P''	73.00	g on a (fig. 3)	155.00 ..
P or P' on g (fig. 2)	122.50	a on g or g on e (fig. 4)	107.00 ..
g' on g'' (fig. 2)....	67.20		

It occurs abundantly in some countries in veins and beds in primitive and secondary rocks, sometimes associated with the red, brown, and black ores of iron, &c. as in Hesse, the Hartz, and Westphalia, where it is worked as an ore of iron; in other European countries it occurs more sparingly; also in North America. It is found in Asia and South America.

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* Spathose Iron [illegible] yellow [illegible]

In Cornwall it is not abundant; but occurs in several of the pper and tin mines, as in Tin Croft near Redruth: in Huel owan near St. Agnes in flat obtuse rhomboids: in Maudlin ine near Lostwithiel in large six-sided prisms consisting of ncentric prisms of different shades of brown: and in small risms of the same form at Botallack mine near the Land's End. the Beeralstone mines in Devonshire in lenticular crystals. is also found in small quantities in Scotland and Ireland. E.CXXXII

Globose Carb. of Iron -

ibrous Carbonate of Iron occurred in the veins of Tin Croft mine in Cornwall in tabular masses of half an inch or less in thickness, striated in a direction perpendicular to the surfaces of the mass, and of a brown colour. 91

assive Carbonate of Iron is generally crystalline, and possesses a lamellar structure.

rgillaceous, or, *Clay Iron-stone*. Thoneisenstein W. Fer oxidé CVI (372 massif & geodique H. It is of an ash-grey colour, sometimes inclining to yellowish and bluish, also brown and reddish brown; the latter is usually the effect of exposure CVII (373 to weather or heat. It occurs in amorphous or flat tabular masses, also in globular and irregularly reniform masses; CVIII (374 the latter are sometimes solid, sometimes hollow, or enclose the same substance in pulverulent slate; in the latter case it is termed *ætites*. The fracture is even, earthy, CCXCVI (5 sometimes flat conchoidal; occasionally the structure is slaty. It yields easily to the knife, and is meagre to the touch. Specific gravity 3.35. It blackens and becomes very magnetic before the blow-pipe. Analysis of a specimen from Low Moor iron works near Bradford, Yorkshire, called *Black Iron-stone*, of the specific gravity of 3.035, by my brother Richard Phillips; protoxide of iron with a trace of oxide of manganese 43.26, carbonic acid 29.30, silex and alumine 20.78, carbonaceous matter 2.67, lime 1.89, moisture 1.00, loss 1.1.

It occurs in beds in the clay-slate belonging to the transition class of rocks? more abundantly in the slate-clay or shale of the independent coal formation.

It occurs in most European countries, but is not abundant in all; also in Siberia and in North America.

In England and Scotland abundantly in many if not
' deposites. Crystals of blende, galena,
are observable in the interstices of the
lnesbury in Staffordshire: some of the
vith calcareous spar.

LXI (376) *Columnar Clay Iron-Stone.* Its colours are the same as the amorphous. It occurs in angular pieces composed of columnar concretions like starch, often closely aggregated and cohering slightly; or the interior is found to be columnar, the interstices being in some cases filled either with bitumen or calcareous spar. It is dull, soft, brittle, and when of a reddish brown colour, is magnetic.

It occurs in Bohemia, the Upper Palatinate, and Saarbruck.

In Scotland in the isle of Arran in the Frith of Clyde. In England in the shale of the Wednesbury coal deposite in Staffordshire, forming columns in the interior of small lenticular masses: the columns are coated with pyrites, and their interstices partially filled with carbonate of lime, sometimes with blende and galena.

Lenticular Clay Iron-Stone. Fer oxidé brun granuleux Bt. It occurs in small granular or lenticular concretions, which are separate or aggregated into masses. Its colour is reddish, or yellowish brown, or greyish black, with a pseudo-metallic lustre. It is brittle, and easily broken.

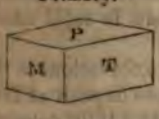
It occurs in Franconia, Bavaria, Salzburg, Switzerland, France, and the Netherlands.

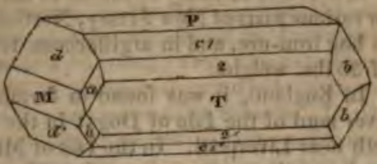
PHOSPHATE OF IRON. VIVIANITE.

III Vivianit W. Fer phosphaté H. Blue Iron ore J. A.

92 XLIV (377) It is of various shades of blue and green, sometimes bluish-green both by reflected and transmitted light. It occurs crystallized in the form of a right oblique angled prism, which is that of the primary crystal. It cleaves readily, and only, parallel to the plane P of the following figures; the crystals are prismatic, and of considerable length, being attached to the matrix at the plane M or the opposite plane, in which case the planes P T and c form the prismatic planes of the crystal. The crystals are often very small, aggregated, and divergent: those of Cornwall are very flexible, but not elastic, while the crystallized variety of New Jersey is extremely brittle. It is easily scratched by fluor. It is also found of an earthy texture and opaque. Specific gravity 2.697. A laminated variety from the Isle of France consisted of 41.25 of iron, 19.25 of phosphoric acid, water 31.25, alumine 5, ferruginous silex 1.25. Before the blow-pipe on charcoal it intumesces, reddens by heat, and then readily fuses into a steel-coloured globule with a metallic lustre.

Primary.





P on M or T ...	90°00′	M on *d* or *d*	150°30′
M on T	125.18	*b* on *b*	148. 5
P on c1	125.56	c1 on *a*	140.35
— — *d*	135.35	— — *d*	134. 5
T on c1	143.40	— — *b*	125.40
— — c2	165.25	— — c1′	108.30
— — *b* or *b*	125.25	— — c2	157.45
M on c1	117.40	*d* on *d*′	120.45

It occurs with iron pyrites and magnetic pyrites in gneiss at Bodenmais in Bavaria, and it is cited by the Comte de Bournon s having been found in a lava of La Bouiche near Nevis in the Bourbonnois; in the Isle of France, and in Brazil; in New Jersey in North America, in the cavities of bog iron-ore, acompanied by the earthy variety: the crystals are transparent when first exposed, but afterwards become blue or green.

In England, it occurs finely crystallized in Huel Kind mine n St. Agnes in Cornwall; accompanied by magnetic iron pyrites nd spathose iron. In Derbyshire, in crystals of the same form nd colour in the decomposed shale of that country.

Earthy Phosphate of Iron. Blaue Eisenerde W. Fer phosphaté terreux H. Blue Iron Earth J. The colour of this mineral on its first exposure is greyish, yellowish, or greenish white, or with a very slight tinge of blue: afterwards it becomes blue of different degrees of intensity. It occurs massive, disseminated in, or coating other substances; and is sometimes loose, occasionally cohering, but very loosely, and with an earthy fracture. It is dull, meagre to the touch, soils the fingers slightly, and is light. It consists of oxide of iron 47.50, phosphoric acid 32, water 20. Klaproth. That of New Jersey consists, according to Vauquelin, of protoxide of iron 44.54, phosphoric acid 25.85, water 28.26, alumine 0.40, loss 0.95. Before the blow-pipe it becomes reddish brown, and then melts into a brownish black slag, attractable by the magnet. X (378)

It occurs in clay, and in mud, supposed to be more or less intermingled with animal matter, from which the phosphoric acid is conjectured to have proceeded.

It is found in many countries of the European continent. In various parts of New Jersey, North America, occasionally in bog iron-ore, and in argillaceous deposits in solid masses of 30 lbs. weight.

In England, it was found in forming excavations in the river mud of the Isle of Dogs; in the same deposit at Toxteth near Liverpool. In the Isle of Man in a light coloured marle, or in peat overlying it. On the surface of peat-mosses in several of the Shetland Isles.

It is sometimes employed as a pigment.

SULPHATE OF IRON. GREEN VITRIOL.

Eisen-Vitriol W. Fer sulphaté H.

CCI (379) XIII (380)

It occurs of various shades of green, sometimes emerald green; but is more often, owing to exposure, of a yellow, or yellowish brown colour externally. It occurs massive, pulverulent, in stalactites, and crystallized in the form of right oblique angled prisms, sometimes modified, but in its native state it is rare.

It occurs in most mines in which sulphuret of iron is found; and in coal mines. It arises from the decomposition of iron-pyrites.

CHROMATE OF IRON.

Chromeisenstein W. Fer Chromaté H. Bt.

LX 93

It is of a black colour; and occurs massive, disseminated in grains, and crystallized in an octohedron, of which any plane on the adjacent plane, affords, by the reflective goniometer, an angle of 109° 28′, and it admits of cleavage parallel to all its planes; it therefore occurs in the regular octohedron, which is its primary form: the massive is sometimes, though rarely, of a perfectly lamellar structure, the fracture being commonly imperfectly conchoidal and uneven, with a shining and somewhat metallic lustre: it is occasionally magnetic; scratches glass, and is opaque. Specific gravity 4.03. That of France consists of 43 chromic acid, 34.7 oxide of iron, 20.3 alumine, silex 2. Vauquelin. But according to Klaproth, the chrome in this mineral is in the state of an oxide.

It occurs in France near Gassin in the department of the Var, in nodules and veins in serpentine, and in the same rock near Nantes; in minute grains enveloped in granular peridot, coloured emerald green by chrome, from the extinct volcanoes of Hildesheim in the ci-devant department of the Kyll in Styria. In the Uralian mountains in Siberia. In the Bare hills near Baltimore, North America, all the varieties occur in veins or masses in serpentine: in Pennsylvania: in New Jersey at Hoboken, in octohedral crystals in serpentine and talcose rocks. In Connecticut, near Newhaven, disseminated in limestone containing serpentine.

In the Isles of Unst and Fetlar, two of the Shetlands, it occurs in serpentine, and in the same rock near Portsoy in Banffshire in Scotland.

It is employed as a pigment, and produces a very fine and peculiar yellow.

ARSENIATE OF IRON.

Wurfelerz W. Fer arseniaté H. Cube-ore J.

It occurs of various shades between light and bottle green; also yellowish brown, yellowish red, and brownish green; it rarely occurs massive, mostly crystallized in cubes, either perfect or having the alternate angles replaced by one, or by three planes, very rarely all the edges and angles are replaced. The small planes *b*, *b*, on the largest of the following figures, appear at first sight only as striæ, apparently indicating the tetrahedron as the primary form; but the crystals yield to cleavage parallel to the planes of the cube, though not with sufficient brilliancy for the use of the reflective goniometer. The cross fracture is uneven or imperfectly conchoidal, with a shining vitreous lustre. It varies from transparent to opaque, yields easily to the knife, and is brittle. It is sometimes ochreous externally, from partial decomposition. Specific gravity 3. It consists according to Vauquelin, of oxide of iron 48, arsenic acid 18, water of crystallization 32, carbonate of lime 2 to 3: or according to x, of oxide of iron 45.5, oxide of copper 9, arsenic ex 4, water 10.5. Before the blow-pipe on chars out arsenical vapours, fusing into a grey scoria brilliancy and attractable by the magnet. It is sure to heat.

LXXXVI
(38

XCVII
(38

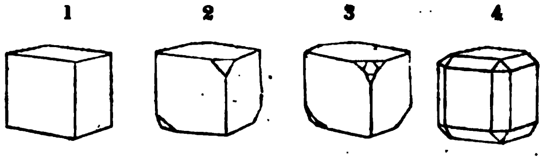
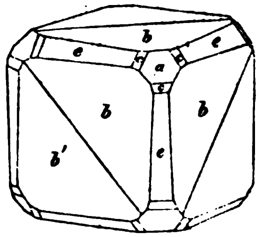


Fig. 1. The cube. Fig. 2. The same, of which the alternate solid angles are replaced by triangular planes. Fig. 3. In which they are replaced by four planes: these are sometimes rounded, and appear but as one plane. Fig. 4. The cube of which the edges and angles are replaced.



b on b or b	93°.40′
b on b'	176 .30
b (upper) on b'.	86 .30

the other planes are dull or somewhat convex.

It is said to have been found at St. Leonard, in the department of Haut-Vienne in France. I possess a foreign specimen, in which cubic crystals of arseniate of iron of a brownish green colour, are associated with martial arseniate of copper and sulphate of barytes, on black hæmatite iron-ore.

It was found in Carharack copper mine in Cornwall sparingly; in abundance in Huel Gorland and Huel Unity mines, near St. Day, in the same vein with native copper, sulphuret, red oxide, arseniate and martial arseniate of copper.

OXALATE OF IRON. HUMBOLDTINE.

Oxalate de Fer. Humboldtine, Mariano de Rivero.

It is described as occurring in small flattish masses of a bright yellow colour, and crystalline, but the crystals are not determinable; it is so soft as to yield to the nail; its specific gravity is 1.3. Analysis by Mariano de Rivero, protoxide of iron 53.56, oxalic acid 46.14. By rubbing it acquires resinous electricity; it decomposes easily on live coals, giving out a vegetable odour, its residue passing by degrees from yellow to black, and finally to red. It is insoluble in boiling water and alcohol.

It is found at Kolowseriex, near Belin in Bohemia, in a moor-coal, or friable lignite, and is supposed by its analyst to result from the decomposition of succulent plants.

It may be questioned whether this substance has yet received all the attention it deserves.

MANGANESE.

Its ores are few; in all of them it occurs combined with oxygen.

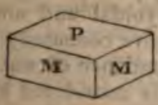
GREY OXIDE OF MANGANESE.

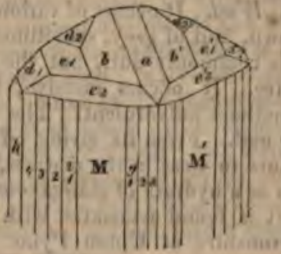
Grau braunsteinerz W. Manganese oxidé metalloïde H.

It is of a steel grey colour, passing into iron black; and occurs in prismatic crystals sometimes modified; the primary crystal may be considered as a right rhombic prism; it cleaves readily and with brilliant surfaces parallel to the lateral planes of a rhombic prism of 100° and 80°, and both its diagonals. It occurs also in acicular crystals longitudinally striated, either in a diverging form, or confusedly intersecting each other: it also occurs massive, with a fibrous structure, or of a granular or earthy texture. It is soft, brittle, marks strongly when rubbed, giving a black dull streak.

The rhombic variety consists of 90.5 brown oxide of manganese, 2.25 oxygen, 7 water, Klaproth: the acicular of 89 brown oxide, and 10 of oxygen, Klaproth.

Primary





P on M or M′	90°.00′	M on *g*2	168°.00′
M on M′	100 .00	—— *g*3	152 .35
P on *a*	115 . 2	—— *h*	130 .00
M on *b* or M′ on *b*′	121 .35	—— *i*1	174 .30
—— *d*1 —— *d*1′	138 . 0	—— *i*2	168 .52
—— *d*2 —— *d*2′	125 . 0	—— *i*3	161 . 0
—— e1 —— e1′	130 .20	—— *i*4	155 .12
—— *e*2 —— *e*2′	149 .30	*d*1 on e1	162 . 0
M on *g*1	171 .30	e1 on *b*	168 .12

It occurs in most of the countries of Europe; frequently in iron mines. It is found both in primitive and secondary countries, in veins, beds, and irregular masses. It occurs in Pennsylvania and Vermont, North America.

In Cornwall, it occurs in argillaceous schist in the parish of Veryan, also near the Indian Queen, near Callington, and near Trebartha, in the same county. In Devonshire, near Upton Pyne, in the neighbourhood of greywacke; where most of the varieties occur. Near Bristol in hollow geodes of quartz; occasionally in small quantity in the mountain lime of that neighbourhood. It also occurs near Aberdeen in Scotland. In Ireland, with brown iron-ore in the peninsula of Howth, near
XXVI Dublin.

(386) *Compact.*—It is externally of a steel grey, passing into black,
with a shining and often semi-metallic lustre; it occurs
stalactitic, botryoidal, and massive; the botryoidal gene-
LXVII rally yields pretty easily to the knife, the massive, with
(387) difficulty, or not at all. It consists of 83.7 oxide of manga-
nese, 14.7 barytes, 1.2 silex, 0.4 carbon, Vauquelin.
XXXV Klaproth found 60 of oxide of manganese, 25 of silex, and
13 of water, but neither barytes nor carbon.

(388) It occurs at Wurselberg in the Hartz, in Nassau, and at Christiansand in Norway.

In England, at Upton Pyne in Devonshire, and in Cornwall.

Earthy. Wad. It occurs of various shades of brown, blackish-brown, and of grey, sometimes approaching to steel-grey. It is commonly dull, but the grey possesses a glimmering lustre. It occurs massive, botryoidal and amorphous, sometimes pulverulent. The massive commonly yields to the nail. From its giving off abundance of water by exposure to heat in the matrass, it is considered by Berzelius as a hydrate of manganese.

It is found associated with iron ores in the Hartz. In Devonshire at Upton Pyne. In Cornwall in Penandrae mine.

HELVIN.*

This substance, so named by Werner, was discovered in the
CLXIV mine called Brothers Lorenz, near Schwartzenburg in Saxony.
It occurs disseminated in a blackish green chlorite mixed with
94 blende, fluor, and steatite, apparently in the form of small re-

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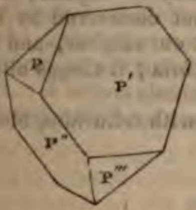
* From the Greek, signifying sun-yellow, in allusion to its colour.

gular tetrahedrons, of which the solid angles are replaced, but it yields to mechanical division parallel to all the planes of, apparently, the regular octohedron: it is of a pale yellowish colour. Before the blow-pipe, on charcoal, in the exterior flame, it fuses into an opaque globule of nearly the same colour as the mineral: with borax, when completely fused, it assumes a deep amethyst colour in the exterior flame.



P on P' or P''.... 109°.30'
P' on P'' or P'''.... 109 .30

But the measurements often vary one degree or even more, owing probably to the crystals having been completely enveloped in the gangue.

It has not been analysed, but from the foregoing and other results obtained by the blow-pipe, it is considered by Berzelius to be a compound of silex and manganese—a silicate of manganese.

SILICIFEROUS OXIDE OF MANGANESE.

Manganese oxidé silicifère H. White Manganese A.

It occurs massive; of a paler red than the carbonated oxide, also brown, reddish or yellowish-brown, or brownish-black. It is said also to occur in curvilinear rhomboids and lenticular crystals? The fracture is even or flat conchoidal: it is translucent on the edges, and is very hard; it scratches glass with ease. Specific gravity 3.2. That of Langbanshytta, lately analysed by Berzelius, consists of black oxide of manganese 52.60, silex 39.60, oxide of iron 4.60, lime 1.50, water 2.75. Analysis by Rose, protoxide of manganese 49.04, silex 48, lime 3.12, magnesia 0.22, protoxide of iron a trace. Alone before the blow-pipe on charcoal, it fuses into a transparent glass of the same colour as the mineral.

&. CLX
9
DXXX
(38

It occurs at Langbanshytta, in Wermeland, Sweden; at Catharineberg in Siberia; also at Kapnic in Transylvania; at the latter place, with quartz, black copper, galena, and sulphuret of manganese.

In Devonshire on Black Down near Tavistock, of a pale rose red, and brownish-black colour, associated with the grey oxide of manganese: it contains crystals of quartz in its cavities. In Cornwall, one mile and a half south-west of Callington, in a manganese quarry.

SULPHURET OF MANGANESE.

·XCI
96

It is of a brownish-back colour, but when fresh fractured of a dark steel-grey: it occurs massive, sometimes botryoidal, with a shining metallic lustre: the fracture is commonly fine grained, but is said to occur in the form of the cube; it is opaque and hard. Specific gravity 3.95. It consists according to Klaproth, of 82 oxide of manganese, 11 sulphur, 5 carbonic acid; the latter ingredient was not discovered by Vauquelin. Before the blow-pipe it gives out sulphur, and may ultimately be reduced to a brownish scoria; it tinges nitrous borax purple.

It occurs at Nagyag in Transylvania, with tellurium, blende, copper pyrites, and ores of manganese.

It is also found in Cornwall.

CARBONATE OF MANGANESE.

Manganèse oxydé carbonatée H.

·XCIV
97

It is described as being massive, of a rose red colour and translucent; and as consisting apparently of small aggregated crystalline masses possessing a lamellar structure: it scarcely scratches glass, and yields to the knife; the fracture is splintery. It consists of oxide of manganese 48, carbonic acid 49, oxide of iron 2.1, silex 0.9.

It occurs at Kapnic in Bohemia.

The four following minerals, described by Leonhard, appear to claim notice in this place; they seem however only to be varieties of the same substance.

1. ALLAGITE.

Allagit, Leonhard.

It is described as being massive, with a flat conchoidal fracture, and as being opaque and nearly without lustre. It occurs both brown and green, but the latter soon changes to a dark grey or black, and the brown into pink brown and pearl grey. It scratches glass, but does not give sparks with the steel. Specific gravity 3.7. The green is fusible with great difficulty to a black pearly glass; the brown with borax into a violet-blue coloured glass. Analysis by Du Menil, oxide of manganese 75.00, silex 16.00, carbonic acid 7.50, with a trace of lime. It occurs in the Hartz, at Schebenholz near Elbingerode, the green with the photizite, the brown in splintery horn mangan.

2. RHODONITE.

Rhodonit, Leonhard.

The Rhodonite appears to occur both compact and of a fibrous texture, and of a pink or rose red, reddish, or yellowish white colour: the fracture is splintery, but the fibres of the fibrous variety may be separated: it is slightly translucent, with a somewhat shining lustre: it scratches glass, and affords sparks with the steel. Specific gravity 3.6. The fibrous, analysed by Brandes, afforded protoxide of manganese 49.870, silex 39.000, carbonic acid 4.000, alumine 0.125, water 6.000, oxide of iron 0.250. It occurs also in the Hartz at Stahlberg near Neuwark, associated with jasper and iron-flint.

3. PHOTIZITE.

Photizit, Leonhard.

The Photizite is also described as being compact, with a flat conchoidal fracture, translucent on the edges, and as varying in colour from white to yellowish brown, green, reddish, and rose red, and as often changing its colour in streaks or spots: it appears to acquire a greasy lustre by exposure: scratches felspar faintly, and gives sparks with the steel. Specific gravity 28—30. Analysis by Brandes of the isabella yellow variety, protoxide of manganese 46.130, silex 39.00, carbonic acid 11.000, oxide of iron 0.500, water 3.000, alumine 0.250. With borax it fuses to a hyacinth red glass. It also occurs at Schebenholz, with allagite, &c.

4. HORN MANGAN. Leonhard.

This mineral also is described as being compact, as affording occasionally a somewhat conchoidal fracture, occasionally splintery, and as being translucent on the edges, glistening, but becoming brilliant by exposure. Its colours are white, grey, and brown of various hues, and greenish blue: it scratches glass faintly, but gives no sparks with the steel. Specific gravity 3.89—3.1. Analysis by Brandes of a variety admitting a conchoidal fracture, protoxide of manganese 54.587, silex 34.00, carbonic acid 8.00, water 2.00, oxide of iron 0.5. When much heated it becomes phosphorescent, and is fusible on the edges; with borax fuses into a glass of a hyacinth red colour. It also occurs at Schebenholz and at Stahlberge with jasper and heavy spar, also with allagite and hornstone.

PHOSPHATE OF MANGANESE.

Phosphormangan W. Manganèse phosphatée ferrifère H.
Manganese phosphatée Bt.

XXIII
98

It is of a reddish-brown, or brownish-black colour; the structure is lamellar, with a brilliant and somewhat chatoyant lustre; according to Haüy it is divisible in directions tending to a rectangular parallelopiped; the cross fracture is flat conchoidal or even. It is opaque in the mass, but thin fragments are semi-transparent. It scratches glass. Analysis of that of Limoges by Berzelius, protoxide of manganese 32.6, phosphoric acid 32.8, protoxide of iron 31.9, phosphate of lime 3.2. Alone on charcoal it fuses very easily with brisk intumescence into a black globule, with metallic lustre, and very magnetic.

It occurs in large grained granite, near Limoges in France. It is said also to occur in Pennsylvania.

MOLYBDENA.*

In the only ore which has been analysed, it is combined with sulphur.

SULPHURET OF MOLYBDENA.

Wasserblei W. Molbybdène fulfuré H. Bt. Molybdena J. A.

XXXVIII
(390)

It is nearly of the colour of fresh cut metallic lead. It occurs massive, of a lamellar structure; and in very flat hexahedral tables, which are readily divisible parallel with their terminating planes; it is also described as having occurred in low double six-sided pyramids with short intermediate prisms. It is opaque, yields to the knife, is flexible but not elastic, unctuous to the touch, gives a metallic grey streak on paper, and on pottery or porcelain a greenish streak. Specific gravity 4.5—47. It consists according to Bucholz, of molybdena 60, sulphur 40. Before the blow-pipe it gives out a sulphureous odour, and when urged by the utmost force of the heat, it gives out white vapours.

It is soluble with violent effervescence in carbonate of soda.

In Norway and Sweden, it occurs imbedded in granite and gneiss; in Bohemia and Saxony with tin: in Silesia, disseminated in granite: in sienite, at Chessey in France: in grey granite, at the foot of the rock Talèfre near Mont Blanc:

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* Molybdena, from the Greek, in allusion to its resemblance in colour to lead.

near Norberg in Sweden, in a white steatite: at Abo in Finland with hornblende; abundantly in several of the United States of N. America, in granite and gneiss, both massive and crystallized. It has been brought from Peru.

In England; with tin and copper in branches from tin and copper veins traversing killas, in Drake-walls mine near Calstock in Cornwall; near Menabilly, and in Huel Unity, and Huel Gorland, traversing killas and granite in the same county. In six-sided tables in granite, near the source of the Caldew, about four miles south-west from Hesket-newmarket, Caldbeck, Cumberland, accompanied by apatite, and iron and arsenical pyrites: in granite at Shap in Westmoreland. In Scotland, with actynolite in chlorite-slate in Glen-elg in Inverness-shire; in six-sided tables in quartz, in granite on the mountain Coryby, at the head of Loch Creran.

OXIDE OF MOLYBDENA.

Molybdena Ocker, Karsten.

It is of a yellow colour of various shades, occasionally of a greenish tint, and is friable and dull. It does not appear to have been analysed, but according to Berzelius, before the blow-pipe, its characters resemble those of pure *molybdic acid;* but treated with soda it sinks into the charcoal, leaving a residuum of protoxide of iron on the surface.

&. CXXXI
99

It is found incrusting the sulphuret of molybdena and between its laminæ, at Nummedalen in Norway, and also at Loch Coryby and Loch Creran in Scotland.

TIN.

The ores of this substance are very few. It was formerly supposed to have been occasionally found in the *Native* or metallic state; but it has of late been well ascertained that the specimens which gave rise to the opinion, were found on the sites of old smelting places, whence they obtained the name of *Jew's-house Tin.* A specimen of this substance was found in boggy ground in the parish of Kea in Cornwall, accompanied by a stratum of charred wood, or charcoal. It contained a vein of a transparent substance, that proved to be *muriate of Tin*, which is almost totally soluble in distilled water. Some specimens have been seen passing into a brown oxide. One in my possession exhibits these appearances.

OXIDE OF TIN.

Zinnstein W. Etain oxydé H. Tinstone J. A.

It occurs almost perfectly transparent, and either colourless or of a yellowish tint; hair-brown, or reddish-brown and translucent; deep brown passing into black, and opaque: the bright yellow and red colours are produced artificially by exposure to heat: when pulverized it is of a greyish-white colour. It rarely occurs massive; mostly in crystals coating cavities in veins, or disseminated; also fibrous and granular. The common form of the crytals is a quadrangular prism terminated by four-sided pyramids (figs. 4 & 5); the structure is lamellar; the natural joints are rarely visible, but the common crystals yield pretty readily to mechanical division parallel with the planes of the prism, and with both its diagonals; they may also be cleaved, with some difficulty, parallel with the planes of the primary octohedron, or, which is the same, with the narrow planes, which appear to replace the pyramidal edges of figure 3. The primary is an obtuse octohedron with a square
XX (391) base; the angle over the apex being 112° 10′, and of a plane of one pyramid, on the adjoining plane of the other, 67° 50′, by the reflective goniometer, from the natural planes. Exter-
XXI (392) nally the crystals are splendent; the cross fracture is uneven, or imperfectly conchoidal, with a more or less shining, resinous
XVII (393) lustre. It gives sparks with the steel and is brittle. Spec. grav. 6.7—7. It consists of tin 77.5, oxygen 21.5, oxide of iron
VIII (394) 0.25, silex 0.75. Klaproth. Before the blow-pipe it decrepitates strongly; when finely pulverized it is reducible on char-
XXV (395) coal, by the continued action of the blow-pipe, to the metallic state.

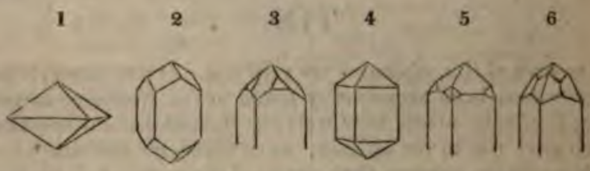
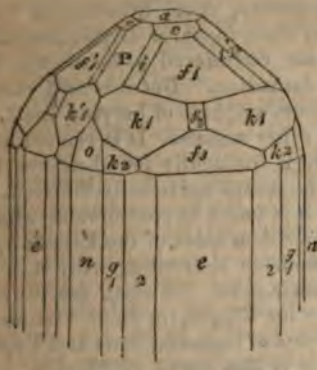
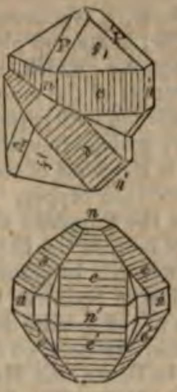


Fig. 1. The primary, an obtuse octohedron; but no crystal has been found of this form; the nearest approach to it is fig. 2, which is prismatic, the planes of the prism arising from the replacement of the lateral solid angles of the primary octohedron by six-sided planes, (see Zircon, fig. 1, 2, 3.) In fig. 3, the angles formed by the meeting of the terminal (primary) planes with the lateral planes, are each replaced by triangular planes; which are complete in fig. 4, (the form of the common crystal) on which no part of the primary is visible. In fig. 5, each solid angle formed by the meeting of the

teral and terminal planes of a crystal similar to fig. 4, is replaced by two riangular planes; which, in fig. 6, are considerably enlarged, and assume nother form.



Macles.



The large figure on the left exhibits a combined view of all the planes hitherto observed on the crystals of oxide of tin; *f*1 and *f*1′ are those of the common pyramid; *e* and *e′* those of the commonly observed prism.

The uppermost of the two figures on the right represents the most common macle of the oxide of Tin, consisting of equal portions of two similar crystals, the lower of which is turned and attached to the upper; the common plane of their attachment being parallel to the plane P′ of the upper half. The lines down the planes *e* of both halves represent the striæ always observable on the prismatic planes of the crystals, and are here represented in order to shew the connexion between this, and the lower of the two macles, which for the sake of illustration is placed in a different point of view; and it will be observed that the lower and apparently dodecahedral macle consists only of portions of the *prisms* of crystals attached together, if we except the small planes, which are parts of P′ and *f*1: only three, or at most four, of these sections are usually to be seen thus attached.

P on P′	133°30′	*f*1 on *f*1 or *f*1′ on *f*1′ over the summit	92°55′
P on P or P′ on P′ over the summit	112.10	— — *f*1′	121.40
P or P′ on *a*	146. 2	— — *f*2	144.10
— — — — *e*	113.20	— — *f*3	142.24
— — — — *f*1	150.45	— — *i*	161.25
P on *i*	169.30	— — *k*1	154.15
P on *k*1 or *k′*1	137.20	— — *k*2	136.20
P on *n*	123.55	— or *f*1′ on *n*	119. 8
— — *o*	140.30	*k*1 on *k*1	159. 5
e on *e′*	90.00	*k*1 on *k*1′	118.10
e or *e′* on *n*	135.00	*k*1 on *e* or *k*1′ on *e′*	155.25
e on *g*1	161.38	*n* on *g*1	153.25
— — *g*2	168.45	— — *g*2	146.20
— — *k*2	171. 5	*e* on *e′* (lower macle)	90.00
*f*1 on *a*	136.30	*e* or *e′* on *n′* ditto	135.00
— — *c*	165.56	*n′* on *n′* ditto	112.10
— — *e* or *f*1′ or *e′*	133.32.30″		

The oxide of tin belongs chiefly, and almost exclusively, to the oldest of the primitive mountains, and is found in veins or beds, mostly the former, in granite, gneiss, mica-slate, and clay-slate. It is often found disseminated in granite. In veins and beds, it is accompanied by quartz, mica, lithomarga, talc, steatite, fluate and phosphate of lime, topaz, wolfram, arsenical pyrites, &c. which, like tin, are considered to be among the substances of the most ancient formation. But it is said rarely to be found with carbonate of lime, sulphate of barytes, lead, or silver, which often accompany other metals. It is remarkable that in the veins of Cornwall tin is frequently found nearer the surface than copper. It is by no means universally diffused.

On the European Continent it is found in considerable abundance both on the Bohemian and Saxon sides of the Erzgebirge, disseminated in granite, and in beds alternating with it. In Gallicia in Spain in beds in mica-slate. In small quantity in veins in the granite hill of Puy les Vignes, in Haut Vienne in France. In Asia, on the east coast of Sumatra, Siam and Pegu; also in Banca and Malacca. It is also found in Mexico, and Chili; in the latter in alluvial deposits. It has lately been found in Greenland by Giesecke.

But the chief deposit of this ore is in Cornwall, where it occurs in veins traversing granite and schist; and is accompanied by chlorite, fluor, quartz, topaz, schorl, actynolite, arsenical pyrites, iron pyrites, copper pyrites, wolfram, and blende: it is also found disseminated in granite, as in that of St. Michael's mount; the ore of almost every mine is in the state of crystals
CXXXVII more or less aggregated; sometimes imbedded in chlorite; and
(396) it is worthy of note, that different veins yield different varieties of form. Pednandrae and the Pell mines yield chiefly if not only, crystals resembling fig. 4. Relistian chiefly fig. 6, which is rare elsewhere.

Fibrous Oxide of Tin. Wood Tin. Kornisches Zinnerz W. Etain oxydé concretionné H. It occurs in reniform, globular and botryoidal masses, or in wedge-shaped pieces which appear to have arisen from the partial destruction of the former: the surfaces are generally water-worn: it is of
CLII various shades of brown, which sometimes appear in con-
(397) centric bands: the structure is divergingly fibrous in one direction, with an occasional appearance of regular form
XLII on the surface, concentric lamellar in the other; the lustre
(398) is glimmering or silky. Specific gravity 6.4. It consists according to Vauquelin, of oxide of tin 91, oxide of iron 9. Before the blow-pipe it becomes brownish red and decrepitates, but is not fused.

It occurs in many of the most important stream-works of Cornwall. A specimen weighing 15 lbs. from near St. Austle, is in the possession of M. Clóse, of Bodmin, who is said to have been offered the sum of £30 for it. Wedge-shaped masses of hæmatites iron, sometimes occur in the stream-works of Cornwall; but are readily distinguished from wood tin by their lightness, and greater brilliancy of colour and lustre.

A new variety has lately been discovered, which has received the name of *Toad's Eye Wood Tin.* It consists of very minute spherical masses of fibrous oxide, of a silky lustre, and of alternate hair-brown and yellowish-white colours disposed concentrically: the fibres radiate from a centre, which frequently consists of a minute globular mass of a deep brown colour. The spherical masses are imbedded in a rock composed of quartz and schorl, or tourmaline, (the schorl rock of Werner) but the wood tin lies chiefly in the quartz. The rock abounds in several mines near Tregurthy moor in Cornwall, where the toad's-eye tin is found, and forms large veins passing through a decomposed granite. A portion of granite was found by M. Majendie attached to a specimen.

Granular Tin. Stream Tin. Etain oxydé granuliforme H. It consists of detached fragments, or of crystals of tin, which sometimes are separate, sometimes imbedded in a rock; it occurs in pieces varying in size from grains of sand to that of the fist.

Deposits of this kind of ore ore found in Chili in South America, but chiefly in Cornwall. They occur in many of the low grounds, marshy places, and even very largely in one or more of the branches of Falmouth harbour. The tin is sometimes accompanied by grains of native gold. The ore is separated from the diluvial matter by passing streams of water over it, whence these deposits are termed *stream works:* the edges of the crystals and masses of tin have been rounded by attrition. CCCXXXVII (399)

It has been found in small quantity at Wicklow in Ireland, accompanying the native gold of that country in an alluvial deposit.

olumbiferous Oxide of Tin. It has lately been discovered at Finbo in Sweden. It occurs in small octohedrons, or more often in grains, which are imbedded in quartz. It is black, with a shade of red or reddish grey: the lustre is metallic, fracture uneven; it is opaque, and hard enough to scratch glass. Specific gravity 6.55. It does not alter before the blow-pipe. It consists of oxide of tin 63.6, oxide of columbium 2.4, oxide of iron 1.4, oxide of manganese 0.8. Another variety affords upwards of 12 per cent. of oxide of columbium. Berzelius.

Oxide of tin has likewise been detected as an ingredient in the columbite of Broddbo and Finbo in Sweden, and less than 1 per cent. in that of Finland; also in the brownish black and yellow yttrocolumbite.

TIN PYRITES. SULPHURET OF TIN.

Zinnkies W. Etain Sulfuré H.

CXXXIX (400) It is massive, of a steel-grey, yellowish-white, or yellow-colour; and these colours are sometimes intermingled in the same specimen, imparting to the mass somewhat of the aspect of bell-metal, whence it is sometimes termed *Bell-metal ore;* the fracture is granular and uneven, passing into flat conchoidal, with a shining metallic lustre. It yields easily to the knife, and is brittle. Specific gravity 4.3. It consists of 34 tin, 36 copper, 25 sulphur, and 2 iron, according to one analysis by Klaproth; but by another of 26.5 tin, 30 copper, 12 iron, and 30.5 sulphur. It does not appear to be understood, whether the sulphur is chemically combined with the tin, or whether the latter is only mechanically mixed with sulphuret of copper and of iron.

It has been found only in Cornwall. It occurred in a vein, 9 feet wide, in Huel Rock in the parish of St. Agnes, accompanied by blende and sulphuret of iron. It is said also to have been found in Stenna Gwynn; in Huel Scorier; and in small veins passing through the granite of St. Michael's Mount.

TUNGSTEN.

The ores of this metal are only three in number; it is found only as an oxide, or in the state of an acid combined with iron, or with lime.

OXIDE OF TUNGSTEN.

Silliman's Journal, Oct. 1821.

This mineral is described as varying in colour from orange yellow and chrome yellow to yellowish grey, and as having very much the appearance of sulphur. It occurs massive, but with some appearance of regular form: it is brittle; its fracture is then conchoidal with an adamantine lustre; it also occurs in a pulverulent form: its specific gravity is 6: it is inodorous, tasteless, unalterable under the blow-pipe, and insoluble in acids; but by digestion in the nitric acid, the powder, which is greyish, assumes a very brilliant yellow colour, and would probably afford a fine pigment. It is readily soluble in warm liquid ammonia, and is precipitated white by acids; the precipitate by standing re-acquires the yellow colour.

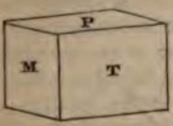
It occurs in quartz, and minute veins with what appears to be tungstate of iron, traversing Mr. Lane's mine (Baltimore?) North America.

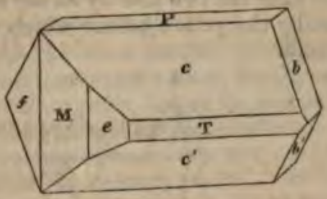
WOLFRAM. TUNGSTATE OF IRON.

Wolfram W. Bt. Scheelin ferrugine H. Bt.

It occurs of a brownish black, and of deep brown colour, and CCCCLVI is found massive and crystallized. The structure is lamellar; it (40 yields to mechanical division parallel to the planes of a right oblique-angled prism, the form of its primary crystal, the angle of the lateral planes of which (M on T) are 117° 22′ by the CLXV (4 reflective goniometer from natural planes; the lustre is brilliant, often metallic; it yields to the knife and is brittle. Specific gravity 7.1—7.3. It consists, according to a late analysis by CLXVI (4 Berzelius, of tungstic acid 78.775, protoxide of iron 18.320, protoxide of manganese 6.220, silex 1.250. Before the blowpipe it decrepitates, and melts without much difficulty into a black and somewhat scoriaceous globule, which does not act on the magnet.

Primary.





M on T	117°22′	M on *c*	110°50′
P on M or T	90.00	*c* on *c*′	101. 5
— — *c*	129.35	*b* on *b*	117.45
T on *f*	90.00	*b* on *f* return	125.48
M on *f*	152.40		

It occurs only in primitive rocks.

It is found in the tin mines of Saxony and Bohemia; in the Hartz in veins traversing greywacké, and in Puy les Mines in France.

In Cornwall, it is the too common concomitant of tin in the numerous veins of that country; it occurred in the form of the primary crystal in Huel Fanny mine near Redruth, and in Gunnis-lake mine on the banks of the Tamar. In Rona, one of the Hebrides, it occurs in veins of graphic granite traversing gneiss.

TUNGSTEN.* TUNGSTATE OF LIME.

Schwerstein W. Scheelin calcaire H. Bt. Le Tungstène Br.

CXXI
100

It is of a greyish and yellowish white colour, and occurs both crystallized and amorphous; the crystals are sometimes externally of a yellowish brown: they occur in the form of an octohedron (fig. 3), but not in the form of the octohedron which has been adopted by Haüy as its primary crystal, which is considerably acute (fig. 1), the angles formed by the meeting of a plane of the upper with the adjoining plane of the lower pyramid being, according to the measurements annexed to the following figure, 128°40′: it yields to mechanical division parallel to both the octodedrons (figs. 1 & 3), with a somewhat shining lustre; it is translucent, and yields pretty easily to the knife. Specific gravity 5.5—6. A specimen lately analysed by Berzelius consisted of tungstic acid 80.417, lime 19.460: another analysed by Bucholz and Brandes, yielded tungstic acid 78, lime 19, silex 2. Before the blow-pipe it crackles and becomes opaque, but does not melt.

This mineral when massive considerably resembles carbonate and sulphate of lead, and also heavy-spar; it may be distinguished from the two first by its not effervescing in acids; from the last by the yellow colour which it assumes when placed in nitric acid.

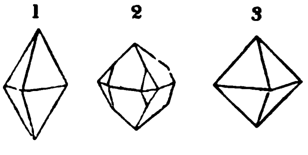


Fig. 1. The primary; an acute octohedron. Fig. 2 represents one of the forms in which this substance occurs; its larger faces arise from the deep replacement of the pyramidal edges of fig. 1, by planes which are parallel therewith; those of the primary crystal being thereby reduced to small triangles. The replacing planes of fig. 2 are complete in fig. 3, forming the octohedron in which this substance commonly occurs, which is less acute than the primary.

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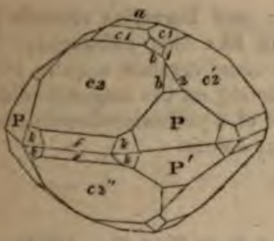
* Tungsten, German; a heavy stone.



P on P′	128°40′	
P on P	100.40	
—— *b*	137.30	B
—— *b*2	150.34	
—— c2 or c2′	136.28	
— or P on *f*	140.20	
P on *k* or P on *k*	152.10	
c1 on c1 over *a*	95.00	B
c2 on c2′	129.40	
c2 or c2′ on *b*2	153.30	
c2 on *f*	160.50	
f on *k* or *k*	152.55	

The above figure (with the exception of the upper planes, which are given on the authority of Bournon) represents a superb crystal in the possession of G. B. Sowerby, nearly of the size of the figure itself, and which he permitted me to measure by means of the reflective goniometer.

It occurs in primitive rocks.

In Sweden it is found in a bed of magnetic iron-stone; in the tin veins of Bohemia and Saxony accompanied by quartz, mica, wolfram and fluor.

In Cornwall it was found accompanying tin in a vein in Pengelly Croft mine in the parish of Breage.

TITANIUM.

The ores of Titanium are not very numerous.

ANATASE. OCTOHEDRITE.*

Octaedrite W. Titane Anatase H. Bt. Octohedrite J. A.

This mineral appears by reflected light of several colours, as blue of various shades, clove-brown or reddish-brown, or steel grey; by transmitted light it is greenish-yellow, bluish, or blue. It mostly occurs in very small crystals, having the general form of an acute octohedron with equal and similar isoceles triangular faces, and of which the common base of the two pyramids is square, which is the form of the primary crystal: the crystals exhibit the planes of several modifications: the structure is lamellar; it yields to mechanical division parallel to the faces of the octohedron, and to the common base of the two pyramids; the lustre of the fragments is splendent and adamantine; it varies from semi-transparent to opaque, scratches glass, and is brittle. Specific gravity 3.8. The experiments of Vauquelin prove it

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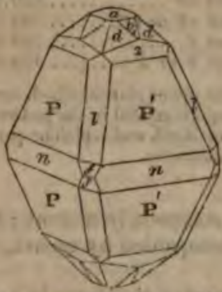
* Anatase, from the Greek, signifying elevated, in allusion to the height of the pyramids of the octohedral crystals; Octohedrite, from its occurring in octohedrons.

E.XXX
/01

to be a pure oxide of titanium; and Berzelius remarks that before the blow-pipe, it behaves like that substance. The Comte de Bournon observes that some crystals acquire by exposure to heat, the property of acting on the magnetic needle, and that many of those which are of a yellowish-brown assume by the same exposure, a deep blue colour.



P on P, or P′ on P′ ...	136°47′
P on P′ or P on P′ ...	98. 5
P or P′ on *a*	111.17
P′ on *b*1	131.22
— — *d* or *d*	132. 5
*b*1 on *a*	160.24
— — *d*	166.30

It is a rare mineral. Near Oisans in Dauphiné it occurs in veins in granite, gneiss, and mica-slate, and is accompanied by felspar, axinite, rock crystal and chlorite. It also occurs in the Grisons. In Norway, in the cavities of transition limestone. In Brazil, enclosed in rock crystal.

The Comte de Bournon cites a crystal on granite from Cornwall, as being in his own collection.

TITANITE.*

Rutil W. J. Titane oxydé H. Rutile Br. Titane Rutile Bt.

Its most common colour is reddish-brown, when it is opaque; it also occurs in prismatic crystals terminated by pyramids, of
XCIX a blood-red colour, and is then translucent or transparent. It
(404) is found in four or eight-sided prisms, either single or geniculated, and commonly striated longitudinally; it also occurs in very minute reticulated crystals: the structure is lamellar; it is mechanically divisible parallel with the lateral planes of a
CLXXXVIII right prism with square bases, which is the form of the primary
(405) crystal; the fragments possess a shining adamantine lustre; the cross fracture is imperfectly conchoidal or uneven with a glistening lustre: it scratches glass, does not yield to the knife, and is brittle. Specific gravity 4.4—4.24. According to the analysis of Klaproth it is a pure oxide of titanium. Before the blowpipe it is infusible by itself; with borax, it melts into a transparent reddish yellow glass.

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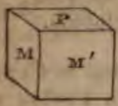
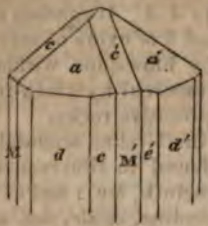
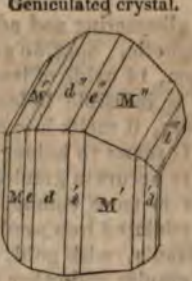
* From its composition.

Primary.





Geniculated crystal.



P on M or M′	90.00′	*a* or *a*′ on *c*′	151°42′
M on M′	90.00	*a* on *d*, or *a*′ on *d*′	132.20
M on *d* or M′ on *d*′	135. 5	*d* on *e*	153.33
M′ on *e* or *e*′	161.40	*a* on *a* over summit	90.00
M on *c* or M on *c*′	122.45	*c* on *c* over summit	109.47
a on *a*′	123.15	M on M″ or M′ or M″ (macle)	134.52

The minute and extremely brilliant crystals represented by the second of the above figures, were presented to me by S. L. Kent, Esq.: the latter represents a brilliant crystal in the possession of H. J. Brooke, Esq.

It occurs chiefly in the veins of primitive rocks.

The reticulated variety occurs in St. Gothard on quartz in the cavities of granite. In Tarentain in spathose iron ore. Titanite is found in Hungary in quartz in the cavities of mica-slate; at Buitrago in Spain in veins in gneiss: at Arendahl in Norway in a vein of granite traversing gneiss: it is also found in Salzburg, France, Hungary, and Transylvania. In several of the United Provinces of North America; occasionally in limestone, sometimes in alluvium. It often penetrates quartz, which is cut and polished to shew the titanium, which commonly is disseminated in extremely slender crystals of a blood-red by transmitted light.

In Scotland, at Cairngorm; at Craig Cailleach near Killin, penetrating quartz imbedded in a rock consisting chiefly of chlorite-slate, and also in calcareous spar; in the crevices of quartz-rock in Ben-gloe. In small crystals in gneiss in the isle of Burray, Shetland; in crystals of quartz in Fife and Perth. In Wales, near Beddgelert in Caernarvonshire; in quartz on Snowdon.

NIGRINE.*

Nigrin W. Titane oxydé ferrifère H. Titan nigrin Bt.

It is of a brownish-black colour, and occurs in small, loose, angular or rounded masses: the structure is lamellar; the cross fracture is flat and imperfectly conchoidal; the lustre is shining or glimmering and adamantine; it is opaque, brittle, and is not magnetic. Specific gravity 4.4. It consists of 84 oxide of titanium, 14 oxide of iron, and 2 of oxide of manganese. Klaproth. It is infusible before the blow-pipe without addition; with borax, it melts into a transparent hyacinth-red globule.

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* From its black colour.

It seems to belong to primitive rocks.

It occurs in granite in the Uralian mountains and in Ceylon; but is more commonly found in alluvium, as in Ceylon with oxydulated iron sand, hyacinth, &c.: and at Ohlapiau in Transylvania, with gold, almandine, rutile, &c. and with fragments of granite and other primitive rocks in yellow sand.

MENACCANITE.

Menacan W. Var. de Titane oxydé ferrifère W. Menakanite Br., Bt.

It is of a greyish or of an iron-black colour, and occurs in very small angular grains, of which the structure is imperfectly lamellar; the fracture is fine-grained and uneven, with a glistening lustre, between adamantine and metallic. It is brittle, yields to the knife, is opaque, and attracts the magnetic needle, but not very strongly. Specific gravity 4.4. It consists of 45.25 oxide of titanium, 51 oxide of iron, 0.25 oxide of manganese, 3.5 of silex. Klaproth. It is infusible before the blow-pipe; but gives to borax a greenish colour inclining to brown.

It first occurred, mingled with quartzose sand, in the bed of a rivulet turning Tregonwell mill near Menaccan,* in the parish of St. Keverne in Cornwall; more recently in a stream near the house of Col. Sandys at Lanarth in the same parish. A variety of titaniferous iron (which indeed is the proper description of the menaccanite) was lately discovered by M. Majendie in a diallage rock near Gwendra on the southern coast of Cornwall.

It has been found at Botany Bay in New South Wales.

ISERINE.

It is of an iron-black colour passing into brownish-black, and occurs in angular grains and rounded pieces; it is a deep black internally; the structure is lamellar, at least in one direction; the cross-fracture is conchoidal, with a brilliant semi-metallic lustre; it is opaque and very hard, and attracts the magnet feebly. It consists of 48 of oxide of titanium, 48 oxide of iron, and 4 oxide of uranium. Thomson. Before the blowpipe it fuses into a blackish brown glass, which is magnetic.

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* Whence Menaccanite.

It was first found near the rise of the stream Iser,* in Silesia, in the Reisengebirge, disseminated in a granitic sand.

In Scotland it occurs in the bed of the river Don in Aberdeenshire, and in small grains on the shore of the Loch of Trista in the isle of Fetlar in Shetland, and together with iron sand is found imbedded in primitive limestone in the neighbourhood.

In England Dr. Traill discovered it, within the last few years, accompanied by magnetic iron sand, on the shore of the Mersey opposite to Liverpool, at Seacome Ferry; it oozes out of a bed of cohering sand, lying beneath a high bank of clay, and may be traced for several miles along the coast.

CRICHTONITE.†

Craïtonite Bournon.

It occurs in very small crystals in the form of acute rhomboids, having the summits replaced, and being otherwise variously modified by secondary planes; the only natural joint is at right angles to the axis of the rhomboid—i. e. parallel to the plane *a*. It is perfectly black, opaque, and of a shining lustre; the cross fracture is conchoidal and very shining. It scratches fluate of lime, but is not very hard. According to Berzelius it affords the same results as titaniferous iron before the blow-pipe; but it may be questioned whether the substance affording this result was not rather a mineral commonly sold under the name of Crichtonite, occurring in thin laminæ and flat crystals, which are incompatible with the rhomboid, and which probably are titaniferous iron: the chrichtonite is understood to be a compound of titanium and silex;—a silicate of titanium.

E.LVII
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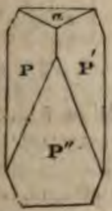

P on P′	61°20′
P or P′ on P″	118.45
— — — on *a*	97.12
P″ on *a*	83.20

The above measurements were afforded by a crystal of this rare mineral in the possession of H. J. Brooke, Esq.; but the planes were not quite even and brilliant.

It occurs accompanying anatase, and on rock crystal in Dauphiné.

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* Whence Iserine.

† In honour of Dr. Crichton.

SPHENE.*

Sphen, Karsten. Titane siliceo-calcaire H.

It occurs of a greyish, yellowish, reddish, and blackish-brown, also of various shades of green, yellowish green, and greenish-white; when pulverized it is greyish-white; it is found amorphous, and in crystals differing greatly in form: the primary form is an oblique rhombic prism, of which the lateral angles are alternately about 133°.30′ & 46°.30′ by the reflective goniometer from natural planes; the structure is lamellar, but its precise directions have not yet been ascertained; it is sometimes translucent on the edges alone; it scratches glass, and is brittle. It consists of 35 of oxide of titanium, 35 silex, 33 lime. Klaproth. It is fusible with difficulty into a blackish glass; with borax it gives a yellowish-green glass.

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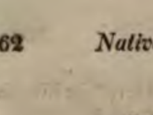
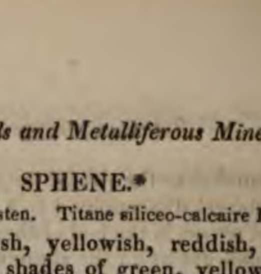
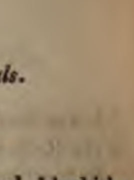
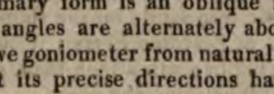
(407)

Primary.

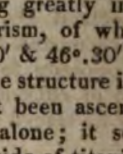








Spinthère.



M on M′	133°30′	M on *l* or M′ on *l*′	151°20′
P on M or M′	121.50	— — c	120. 2
— — *a*	159.44	*b* on *b*′	167.00
— — c	140.52	*b* or *b* on c	139.30
— — *e*2 or *e*2′	158.18	c on d1 or *d*1′	146.44
— — *e*3 or *e*3′	154.20	— — *e*2	145.18
— — *e*4 or *e*4′	146.30	— — *e*4	154.52
— — *e*5 or *e*5′	120. 2	*d*1 on *d*1′	113.24
M or M′ on *a*	139.30	*d*2 on *d*2′	135.60
M on *b* or M′ on *b*′	124.35	*d*2 on *e*4	152.30
M or M′ on c	86.20	*d*1 on *e*2	152.45
M on *e*2 or M′ on *e*2′	119.35	*e*1 on *e*1′	175.42
— — *e*3 or — — *e*3′	116.42	*e*2 on *e*2′	136.50
— — *e*5 or — — *e*5′	138.42	*e*4 on *e*4′	113.40

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* Sphene, from the Greek: probably in allusion to its crystals being somewhat wedge-shaped.

It occurs in primitive rocks chiefly.

In Sweden and Norway in granite; in Norway in primitive limestone; in sienite at Passau on the Inn; on St. Gothard with chlorite on granite; in the same rock in Maryland and Pennsylvania, and in other of the United States in limestone. It occurs at Andernach and the Puy de Dome in volcanic rocks. E.CXXXV The substance described by Haüy under the name of *Spinthère*, 163 is only a variety of Sphene (see preceding crystalline form); it is found in Iseré in France on crystals of carbonate of lime.

In Scotland, in sienite, in the Criffle and other hills in Galloway, on the south side of Lough Ness, in the mountains round the King's House, in Ben Nevis, in Culloden in Aberdeenshire, and in the granite of Aberdeen: in the flœtz traps of Mid Lothian. On the shore of Loch Triesta in the Isle of Fetlar in Shetland, and in porphyritic gneiss at Altaness in the Isle of Burray.

In Ireland, sparingly in thin flakes between laminæ of mica-slate, in the town land of Carriglinneen.

CERIUM.*

Of this rare metal, the ores have received a considerable accession by late discoveries, but the greater part of them were found in very small quantity; one or more of them so sparingly that the whole quantity scarcely sufficed for one analysis. The accounts of some of them, both as regards their chemical and external characters, are yet very imperfect.

CERITE.

Cerit, Hisinger & Berzelius. Cerium oxydé silicifère H.

Its colour is between rose red and flesh red, occasionally with E.XXV a tinge of brown; when pulverized, it is grey; it occurs both 104 massive and disseminated; the fracture is splintery and more or less shining, sometimes only glimmering: it is opaque, scratches glass, gives sparks with the steel, scarcely yields to the knife, and is hard, and difficultly frangible. It consists of 54.5 oxide of cerium, 3.5 oxide of iron, 34.5 silex, 1.25 lime, 5 water, Klaproth; but according to Vauquelin, 67.0 of oxide of cerium, 17 of silex, 2 of oxide of iron, 2 of lime, 12 of water and carbonic acid. Before the blow-pipe on charcoal it splits but does not fuse; with borax it fuses slowly.

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* Cerium; after the planet Ceres.

It is found only in the copper mine of Bastnaes near Riddarhytta in Sweden, and is accompanied by the ores of copper, molybdena and bismuth; also with mica and hornblende; the cerite is sometimes disseminated among the two latter: the mine is in gneiss.

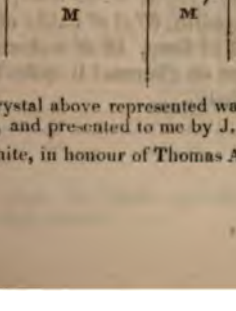
ALLANITE.*

LVIII

Allanite, Thomson. Cerium oxydé silicifère noire, Lucas.

105 It is of a brownish-black colour, when pulverized of a greenish-grey. It occurs massive, and in prismatic crystals, variously terminated; the planes and measurements of the following figure indicate the primary form to be a right square prism, XXII but no appearances of internal structure have hitherto been observed: the fracture is uneven, passing into small conchoidal, 106 with a shining resino-metallic lustre. It is generally opaque even in the smallest and thinnest fragments; rarely slightly translucent and of a yellowish brown. It is of about the same hardness as glass, and is brittle. Specific gravity 3.1—3.4. It consists of 33.9 oxide of cerium, 25.4 oxide of iron, 35.4 silex, 9.2 lime, 4.1 alumine, 4 water. Thomson. In the forceps or on charcoal, a small fragment merely becomes greenish yellow on the surface, but does not fuse with an intense heat. Children. Another specimen frothed and melted imperfectly into a black scoria. Thomson.

It is often difficult to distinguish this mineral by its external characters from gadolinite. Bournon points out the following as the most certain amongst them; thin fragments of the gadolinite are translucent on the edges and of a fine green colour; the allanite is commonly opaque, rarely translucent and of a yellowish-brown.



P on M or M'	90°. c. g.
M on M'	90 . ..
P on *b*, or *b'*	120 . ..
M on *b*, *b*, or *b'*	150 . ..
b on *b*	150 . ..
b or *b* on *c'* or *b'* on *c'*	160 . ..
c on c'	100 . ..

The crystal above represented was brought from Greenland by Professor Geisecké, and presented to me by J. G. Children, Esq.

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* Allanite, in honour of Thomas Allan, Esq. of Edinburgh.

It occurs in a granite rock in West Greenland, and was discovered by Professor Geisecké, but was first noticed and recognized by T. Allan, Esq. of Edinburgh.

A variety of the ores of cerium has been announced under the name of *Cerin*, which however has not been described. By the analysis of Berzelius, it appears to be nearly allied to allanite in composition. It consists of oxide of cerium 28.19, oxide of iron 20.72, oxide of copper 0.87, silex 30.17, alumine 11.31, lime 9.12, volatile matter 0.40.

ORTHITE.

The Orthite always occurs in straight[*] seams or layers, sometimes in felspar. It resembles gadolinite, but differs in fusibility. It is composed of protoxide of cerium 19.50, protoxide of iron 12.44, protoxide of manganese 3.44, yttria 3.44, silex 32.00, alumine 14.80, lime 7.84, water 5.36. Berzelius. Alone on charcoal before the blow-pipe it intumesces, and fuses into a black blebby glass; with borax dissolves readily into a glass which when hot is red, when cold yellow.

E. XCV
10

It was found in the mine of Finbo, in the neighbourhood of Fahlun in Sweden. That mine is situated on a granite vein traversing gneiss, in one place more than 12 feet wide.

Several other minerals containing cerium have been discovered in the same mine, or near the same place; but no satisfactory descriptions of these minerals have yet been published in this country; some of them have been analysed by Berzelius.

A variety of orthite was discovered in another granite vein near Fahlun, which has the curious property of taking fire before the blow-pipe and of continuing to burn for some moments. It has received the name of *Pyrorthite*. Besides the same constituents as the orthite, it contains 25 per cent. of carbon.

YTTROCERITE.[†]

The colour of this newly discovered mineral is various; violet, greyish-red, greyish-white, are often mingled in the same specimen. It occurs in amorphous masses, varying from a thin crust to half a pound in weight; also investing. It is opaque; the structure is lamellar, with a glistening lustre; it yields to the knife, but scratches fluor. Specific gravity 3.447. Before the blow-pipe it loses its colour and becomes white, but does not fuse of itself; but when gypsum is added it readily melts into

E. CX
108

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[*] Whence Orthite, from the Greek.

[†] From its consisting chiefly of yttria and cerium.

a bead. By one analysis, it appears to consist of oxide of cerium 13.15, yttria 14.60, lime 47.77, and fluoric acid 24.46. By another, fluate of lime 68.18, fluate of yttria 10.60, and fluate of cerium 20.22. Berzelius. On charcoal, before the blow-pipe alone, it does not fuse; by the addition of gypsum it melts into an opaque globule.

It has been found only at Finbo near Fahlun in Sweden, upon or disseminated in quartz, or investing the pyrophysalite.

SUB-FLUATE OF CERIUM.

In this mineral the fluoric acid is combined with twice as much of the peroxide and protoxide of cerium as in the succeeding mineral. It is described as possessing a strong resemblance to porcelain jasper. Its colour is yellow, and its form has some appearance of crystallization. Before the blow-pipe on charcoal it is infusible, but on cooling becomes first brown, then red, and lastly orange.

Berzelius also mentions a *Fluate of Cerium*, as not yet analysed: nor am I aware that it has been described. He observes that on charcoal it does not fuse; turns opaque at a low heat; becomes by the fire rather darker; and presents the same changes of colour as the preceding.

NEUTRAL FLUATE OF CERIUM.

It has also been termed

Deuto-fluate of Cerium.

This very rare mineral has been found only at Finbo, Broddbo and Bastnaes in Sweden, and even there so sparingly, that all the specimens that were found scarcely sufficed Berzelius for a single analysis. That of Finbo is of a deeper red than that of Broddbo. It has occurred in six-sided prisms, in plates, and in amorphous masses. It is composed of fluate of protoxide of cerium 30.43, fluate of peroxide of cerium 68.00, with some traces of fluate of yttria. Berzelius. Before the blow-pipe on charcoal it does not fuse, but merely turns of a slightly brown colour.

It is imbedded in a rock composed of albite, quartz, and mica, and is accompanied by emeralds and yttrocolumbite.

By one analysis this mineral yielded a proportion of the new earth *Thorina*, but the analysis was incomplete.

This new earth has likewise been detected by Berzelius in a mineral to which he has given the name of

DOUBLE FLUATE OF CERIUM AND YTTRIA.

This is an earthy mineral found at Finbo in Sweden, which is much more common than the preceding, but its size seldom exceeds that of a pea. It is commonly of a pale red colour, but occurs deep red, yellow, and even white. It may easily be scratched by the nail. It also occurs in amorphous masses of a reddish brown colour, which sometimes are separate, sometimes invest gadolinite, or are mixed with it so as to appear a part of it. Several analyses gave different results.

URANIUM.*

Its ores are only two in number.

URAN-OCHRE. PITCH-BLENDE.

Pecherz W. Urane oxydulé H. Uran-ochre J. Pitch Blende A.

It is brown, greyish, brownish-black, and black; and occurs globular, reniform, massive, disseminated, and pulverulent; the fracture is uneven, or small conchoidal; it is sometimes dull, but more often possesses a shining resinous lustre; it is opaque, or occasionally translucent on the edges, and is very brittle, but sometimes scratches glass. Specific gravity 7.5. It consists according to Klaproth, of 86.5 oxide of uranium, 6 of galena, 2.5 black oxide of iron, and 5 of silex. It is infusible before the blow-pipe; with borax it yields a grey slag. E. CXXV (1

It generally accompanies uranite.

In Cornwall, it accompanied uranite in Tin Croft mine, both amorphous and in globular masses of a brown colour; in Tol Carn mine, of a black colour with uranite, and disseminated in the vein.

URANITE. PHOSPHATE OF URANIUM.

CCCCLXXX (4

Uran glimmer W. Urane oxydé H. Urane micacé Br. Urane micacé oxydé Bt. Uran-mica J. Uranite A.

It occurs of a lemon-yellow, gold-yellow, yellowish-brown, also of apple and emerald-green; the same crystal is sometimes yellow at one end, green at the other; it becomes brownish and dull by decomposition. It is found crystallized in quadrangular prisms, in four, six, and eight-sided tables, rarely in acute and CXXV (4 CXXVI (4 obtuse octohedrons: the structure is lamellar, and it is mechanically divisible parallel to all, and with remarkable ease to the terminal planes of a right square prism—the form of the primary crystal. It varies from transparent to opaque; the lustre is shining; it yields easily to the knife, and is brittle. Specific gravity 2.19. The green variety of Cornwall consists, according to Gregor, of oxide of uranium, oxide of copper, and water 15.4. Klaproth considered the yellow to be a pure oxide of uranium. Berzelius, on analysing the yellow of Autun, was led to the conclusion, that it is a uranate of lime, containing much water of crystallization, and that the green of Cornwall is the same combination coloured by arseniate of copper. The green variety of Gunnis-lake mine in Cornwall has since been analysed by my brother Richard Phillips, who finds it to be a phosphate of uranium coloured by phosphate of copper, containing water, and consisting of oxide of uranium 60.0, oxide of copper 9.0, phosphoric acid 15.3, water 13.8, silex 0.5, loss 1.4. It decrepitates violently on charcoal before the blow-pipe, loses about 33 per cent. by ignition, and acquires a brassy colour; with borax it gives a yellowish green glass. It is soluble with effervescence in nitric acid.

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* From the Greek, signifying Heaven.

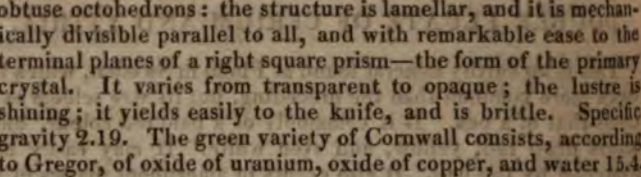
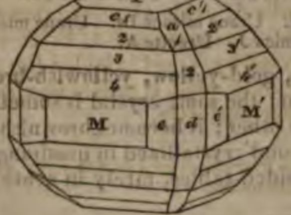


Fig. 1. The primary, a right square prism. Fig. 2, a tabular crystal of a quadrangular form; these occur of various lengths. Fig. 3. In this, the solid angles of the preceding are replaced, producing a six-sided tabular crystal; these are commonly very long. Fig. 4. In this, all the terminal edges of the quadrangular prism are replaced, tending to produce an octohedron, which sometimes occurs. In fig. 5, the solid angles of the prism (fig. 1), are replaced by triangular planes. In fig. 6, all the edges and solid angles of the quadrangular prism are replaced.



P on M or M'	90°00' *c.g.*
M on M'	90.00
P on c1 or c1'	145.32
— — c2 or c2'	140.40
— — c3 or c3'	137.10
— — c4 or c4'	111.50
— — *a*2	134.00
c4 on c4'	97.32

It is generally found in granite.

It occurs in veins in granite at St. Symphorien near Autun, and also at St. Yrieux near Limoges in France: and is found at several places in Saxony. Near Baltimore in Maryland, and at Brunswick in Maine, North America?

In Cornwall, it occurred in veins passing through granite in Carharack mine; with uran-ochre on masses of granite in the veins of Tin Croft mine near Redruth, and in Huel Buller near the same place; in decomposed granite with pulverulent black uran-ochre in Tolcarn mine near St. Day; on red oxide of copper and with cubic arseniate of iron in Huel Gorland and Huel Unity, the veins of which pass through granite and schist; in Huel Edward in St. Just; in St. Agnes; also at Stenna-Gwyn, near St. Austle, on wavellite (upon decomposed granite?); and in Gunnis-lake mine near Callington.

COLUMBIUM.*

The ores of this metal are few, and occur very sparingly.

COLUMBITE.*

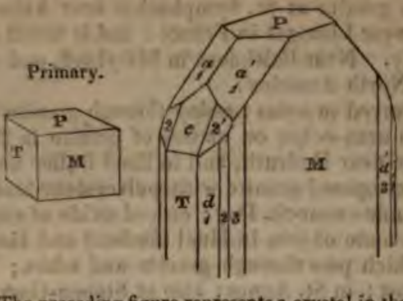
Columbite, Hatchett. Tantalit Karsten. Tantale oxydé ferró-manganèsifère H. Tantalite J. A.

It is of an iron-black colour, sometimes with a tinge of blue; it occurs in single crystals, and in small crystalline masses: the crystals are mostly incomplete, but possess the general form of flat quadrangular prisms, striated longitunally, shining externally, and variously modified. The primary form appears to be a right rectangular prism. It is opaque, scratches glass, and gives sparks with the steel. Specific gravity 6.46—7. That of North America consists, according to Wollaston, of oxide of columbium 80, oxide of iron 15, oxide of manganese 5. Analysis by Berzelius of that of Finland, oxide of columbium 83.2, protoxide of iron 7.2, protoxide of manganese 7.4, oxide of tin 0.6. That of Bodenmais, analysed by Vogel, yielded the same constituents. Alone, before the blow-pipe, it suffers no change; with borax it dissolves slowly but perfectly.

§. VI.

§. XCV

*** Columbite, from its having been first discovered in America; whence Columbium, the designation of the pure metal.**



P on M or T	90°00
M on T	90.00
P on *a* 1 or *a* 1′	136.30
— — *c*	120.00
T on *d* 1	156.30
— — *d* 2	114.30
— — *e*	150.00

The preceding figure represents a crystal in the possession of H. J. Brooke, Esq. of about the same size as the sketch: I am also indebted to him for the measurements.

It is said to have been first discovered at New London in Connecticut, North America, but its precise locality is unknown: it has since been found at Kemito in Finland; more lately at Bodenmais in Bavaria in pretty large prismatic crystals.

Stanniferous Columbite. It is described as occurring in amorphous masses without any external appearance of crystallization, or of regular internal structure. Its colour is an uniform black: the fracture is uneven. The fragments are indeterminate, opaque, and their lustre is metallic. It scratches glass, but is scratched by quartz, and gives no sparks with the steel. The specific gravity of the larger masses is 6.291; of those of inferior size it is less. It is not alterable before the blow-pipe per se: but with phosphate of soda or borax, it fuses into a yellowish glass. By one analysis, Berzelius found it to consist of oxide of columbium 66.66, tungstic acid 5.78, oxide of tin 8.02, oxide of iron 10.64, oxide of manganese 10.20. These ingredients varied a little in two other analyses, which afforded nearly 2 per cent. of lime. Berzelius considers the tungstic acid and oxide of iron to have existed in the mineral in the form of tungstate of iron.

It was found at Broddbo in Sweden: that of Finbo, which occurred in small grains or crystals imbedded in quartz, consists according to Berzelius, of oxide of columbium 66.99, oxide of tin 16.75, oxide of iron 7.67, oxide of manganese 7.98, lime 2.40.

A variety has more lately been found at Bodenmais in Germany: its specific gravity is 6.464. It is described as yielding by mechanical division a four-sided prism, of 94°

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(111

and 86°, terminated by oblique faces. By the analysis of Vogel it consists of oxide of columbium 75, protoxide of iron 17, protoxide of manganese 5, oxide of tin 1.

YTTROCOLUMBITE.*

Yttrotantal, Karsten. Tantale oxydé yttrifère H. Yttrotantalite J. A.

It is of an iron-black colour, when pulverized greyish. It is said also to occur of a yellowish-brown and brownish-black colour. E. XLV. / It is described as occurring in imbedded in angular pieces, sometimes as large as a hazel nut; also, it is said, in rhombic prisms. Internally it is compact, or has a granular fracture with a shining metallic lustre; it is opaque, and yields with difficulty to the knife. Spec. grav. 5.1. Under the blowpipe it first decrepitates, but melts by an increase of heat, into a greenish-yellow slag. It consists according to Vauquelin, of 45 oxide of columbium, 55 of yttria and oxide of iron. Berzelius considers the black and the yellow to be mechanical mixtures of sub-columbate of yttria, with small quantities of the sub-columbates of lime and uranium, and sometimes with columbite and tungsten.

It occurs with gadolinite, in a bed of flesh-coloured felspar, in gneiss at Ytterby near Roslagen in Sweden, and at Finbo.

More lately it has been found crystallised by Sir C. Giesecké, at Rickerlamsan, near Cape Farewell, in Greenland, imbedded in quartz. The fragments are translucent, of a greenish brown colour; the fracture is conchoidal with a brilliant metallic lustre. Spec. grav. 5.838.

CHROME.†

OXIDE OF CHROME.

Dr. MacCulloch.

It occurs both of a bright grass green, and of a pale yellow colour: both varieties are sometimes in the form of a powder, E LIX // and are then dull; but the green is occasionally compact, bearing the marks of a crystalline structure, and somewhat translucent; the lustre then resembles that of compactly crystalline

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[*] From its consisting chiefly of Yttra and Columbium.

[†] Meaning, a colouring substance; probably in allusion to its preparation as a pigment.

limestone and marbles. The green changes to yellow by heating it, whence they have been supposed by Vauquelin to exist in different states of oxidation.

It is soluble by boiling in the alkalies, and communicates to them a green colour; but the solution is decomposed by further boiling, and the oxide is precipitated. By this character, and by its communicating a green tinge to glass before the blow-pipe, it may be recognised and distinguished.

It occurs in Unst, one of the Shetland Isles, investing the surface, or filling cavities in the chromate of iron, which abounds in this island, so as for the space of many miles to be scattered over the surface of the ground, and even to be used, in common with the loose stones which it accompanies, in the building of dykes.

The Comte de Bournon cites it in a pulverulent state, and in a siliciferous state, possessing a green colour more or less intense in proportion to the quantity of silex it incloses, from Ecouchets in Burgundy. Also as the colouring matter of a green quartz, greatly resembling prase.

Dr. MacCulloch is of opinion that the chrome oxide of Lucas is a compound mineral, and that of Unst a pure oxide.

BISMUTH.

Bismuth is found in the native state, and there are several varieties of its ores.

NATIVE BISMUTH.

Gegieden Wismuth W. Bismuth natif H.

Its colour is silver-white tinged with red, generally with an external tarnish; it occurs feathery, reticulated, amorphous, and also, it is said, crystallized in the form of the regular octohedron, (its primitive crystal) and acute rhomboid; its structure is lamellar, with joints parallel to the planes of the regular octohedron, and probably also in other directions; it is soft, sectile, and not very frangible. Spec. grav. 9. When placed on a live coal, or subjected to the heat of a candle, it melts; before the blow-pipe it melts, and is volatilized in the form of a white vapour, giving out generally an arsenical odour from an admixture of arsenic.

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It chiefly occurs in the veins of primitive mountains, in a gangue of quartz, calcareous spar, induratrd clay, or jasper, and is accompanied by ores of cobalt and nickel, sometimes of silver, and lead.

In Europe, it occurs most abundantly at Johann-georgenstadt and Schneeberg in Saxony, and at Joachimstal in Bohemia: it also occurs in Transylvania, Swabia, France, Norway, and Sweden. At Trumbull in Connecticut in N. America, in tabular masses, with the sulphurets of iron and lead.

It occurs in the western part of Cornwall, disseminated in an argillaceous rock; its precise locality is unknown; but it has been found in Botallack, and in St. Columb: it occurs in feathery masses, with arsenical cobalt, in Huel Sparnon, close to Redruth: in Herland mine near St. Ives.

SULPHURET OF BISMUTH.

Wismuthglanz W. Bismuth sulfuré H. Bt. Bismuth Glance J.

It is of a colour between tin-white and lead-grey, but is sometimes yellowish-white; it occurs disseminated in crystalline prisms, which occasionally radiate, and in minute crystals deeply striated longitudinally, in the small cavities of the mass. It cleaves parallel to the planes P and *f* of the following figure, and at right angles to the latter, affording the measurement of 90° by the reflective goniometer; there are also indications of cleavages parallel to the planes of a right rhombic prism of about 130° & 50°; the principal cleavage is parallel to the plane *f*. It is soft and brittle. Spec. grav. 6.1. It melts in the flame of a candle; before the blow-pipe it is for the most part volatilized with a sulphureous odour, leaving a residue which is reducible with difficulty to the metallic state.

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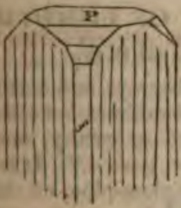

The minute crystal represented by this figure is not sufficiently brilliant for measurement by the reflective goniometer; the lines parallel to the plane *f* represent the striæ constantly observed on the crystals, but which in reality are a series of planes.

It chiefly occurs in the veins of primitive mountains, &c. accompanied by native bismuth, and some of the ores of cobalt, iron, and arsenic.

In Europe, the localities are pretty much the same as those of native bismuth.

In Cornwall, it occurs in small and very brilliant tin-white crystals in Huel Sparnon near Redruth; in minute crystals of a yellowish-white disseminated in a sort of jasper, at Botallack near the Land's End: it is said also to have occurred in Herland mine.

Cupriferous Sulphuret of Bismuth. Kupferwismutherz W. It is of a lead-grey, steel-grey, or tin-white colour, with a yellowish or reddish tarnish; and occurs massive, disseminated, and acicular; the fracture is small grained and uneven; it is sectile. It consists, according to Klaproth, of 47.24 bismuth, 34.66 copper, 12.58 sulphur.

It has only occurred in certain mines near Wittichen in Furstemberg, in veins traversing granite.

Plumbo-cupriferous Sulphuret of Bismuth. Nadelerz W. Bismuth sulfuré plumbo-cuprifère H. It is of a steel-grey colour, with a yellowish tarnish. It occurs disseminated, and in acicular four or six-sided prisms, striated longitudinally; the structure is lamellar; the cross fracture small-grained and uneven, with a shining metallic lustre; it yields easily to the knife. Spec. grav. 6.125. It consists of bismuth 43.2. lead 24.3, copper 12.1, nickel 1.5, tellurium 1.3, and sulphur 11.5, John. Before the plow-pipe it fuses into a steel-grey globule: by continuance of heat it partly volatilizes and deposits on the charcoal a yellow powder, after which there remains a red globule, enclosing a grain of metallic lead.

It has only been found near Beresof in Catharinenberg in Siberia, imbedded in quartz, and accompanied by galena and native gold.

BISMUTH OCHRE. OXIDE OF BISMUTH.

Wismutocher W. Bismuth oxydé H. Bt.

It is of a greenish-yellow or yellowish-grey, and occurs massive and disseminated; the structure is sometimes lamellar, with a shining lustre; sometimes fine-grained or earthy, and dull: it is opake, soft, and often friable. Spec. grav. 4.7. It is easily reduced to the metallic state, before the plow-pipe, on charcoal.

It has been found at Schneeberg and Johann-georgenstadt in Saxony, and at Joachimstal in Bohemia.

CARBONATE OF BISMUTH.

Of this substance no precise description has been given. It is noticed and figured in Sowerby's English Mineralogy, Tab.

344, as having been sent to him by the late Rev. W. Gregor, by whose experiments it appeared to consist of carbonate of bismuth, with some oxide of iron and earthy matter. It was found at St. Agnes in Cornwall. It had the appearance of an earthy substance, and somewhat resembled steatite. It is said also to have occurred at Tregurthy and St. Columb in Cornwall. CCCXLIV (412

It has been doubted whether the same substance has not been described by Friesleben under the name of ***Arsenic Wismuth* (*Arsenical Bismuth.*)**

ARSENIC. *

It is found in the native state; its ores are but few.

NATIVE ARSENIC.

Gediegen arsenic W. Arsenic natif H.

It is of a greyish-black, and is dull externally; internally, when fresh broken, of a lead-grey colour, inclining to tin-white; it occurs reniform, botryoidal, and in flat mamillary masses; also exhibiting cavities in the forms of the cube, octohedron, &c.; the structure of the former is concentric lamellar, the cross fracture is fine grained and uneven, occasionally with a slight appearance of a fibrous structure; it yields to the knife, and is easily frangible. Specific gravity 5.7. Before the blowpipe it readily fuses, and burns with a bluish flame and a dense white arsenical vapour; and is volatilized with the exception of a minute portion of iron, which sometimes is mixed with silver or gold. S. XLVII 116

It occurs chiefly in the veins of primitive rocks, accompanying the ores of silver, cobalt, and copper, &c.

It is found at Kongsberg in Norway, in the Hartz, in Bohemia, and several other European countries, and sparingly in North and South America.

OXIDE OF ARSENIC.

Arsenikblüthe, Karsten. Arsenic oxydé H.

It is of a snow-white, but sometimes tinged accidentally reddish, yellowish, or greenish. It occurs earthy, capillary, in-

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[*] It is said by Haüy that Arsenic is derived from the Greek, signifying a male; in allusion to the great power of the metal.

vesting other substances, in stalactites, and also it is said, in tabular and prismatic crystals. The cleavage is described by the Comte de Bournon as being octohedral. Before the blow-pipe it gives off the smell of garlic, and finally evaporates.

It occurs at Andreasberg in the Hartz, with the ores of silver, arsenic, and lead: also at Joachimstal, in the Pyrenees, and in France.

It resembles the pharmacolite, and is often confounded with it, but that substance is not soluble in water, which the oxide of arsenic is.

SULPHURET OF ARSENIC.

Of this substance there are two varieties.

1. REALGAR.

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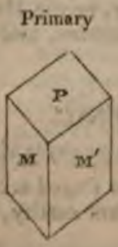
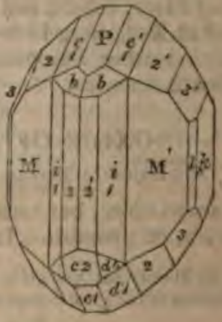
It is of a brilliant red, passing into scarlet, sometimes with a tinge of orange, and is translucent, rarely transparent. It occurs massive, disseminated, investing, acicular, and crystallized; the crystals usually assume the prismatic form, and are externally very brilliant. It cleaves parallel to all the planes of an oblique rhombic prism, whose lateral planes are 74°.15′ & 105°.45′ by the reflective goniometer from cleavage planes, the terminal on a lateral plane being about 104°.6′: the declination of the terminal plane is from one acute angle of the prism to its opposite. The cross fracture is conchoidal, with a splendent vitreous lustre; the streak is orange-coloured; it is so readily frangible as to yield to the pressure of the nail. Specific gravity 3.3. It consists of arsenic 69, sulphur 31. Klaproth. It becomes electric by friction, acquiring the resinous or negative electricity; before the blow-pipe alone on charcoal, it burns with a pale yellow flame.

Primary





M on M′	74°.15′	M′ on *e*′2	135°. 2′
P on M or M′	104 . 6	—— *e*′3	141 .20
—— *b* or *b*	149 .12	—— *i*1	172 . 6
—— *c*2	80 . 0	—— *i*2	160 .42
—— *e*1 or *e*1′	156 .30	—— *k*	142 .42
—— *e*2 or *e*2′	138 .22	—— *l*	163 .35
—— *e*3 or *e*3′	126 .50	c1 on c2	150 .38
—— *k*	90 . 0	—— *d*1	155 .10
M on *b* or M′ on *b*′	133 . 2	—— *d*2	137 .20
M or M′ on c1	99 .30	—— *d*3	125 .41
———— c2	115 .52	—— *k*	90 .00
M′ on *d*1	119 .30	*c*2 on *d*4	161 .20
—— *d*2	131 .34	*i*2 on *i*2′	112 .55
—— *e*′1	122 .50		

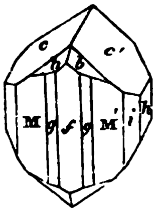
It occurs in the veins of primitive rocks, and among volcanic matter.

It is found at Andreasberg in the Hartz; in dolomite on St. Gothard; finely crystallized in Bohemia: De Born mentions a vein of it between Gallicia and Transylvania, about twelve feet wide: also in Saxony. Among the volcanic matter of Vesuvius, Solfatara, &c.

2. ORPIMENT.

E.L.

It is of a bright lemon-yellow colour passing into gold-yellow;* it occurs disseminated, reniform, in stalactites, investing, and also, though rarely, in minute crystals. The primary form appears to be a right rhombic prism of 100° & 80°, but the crystals yield to mechanical division parallel only to the greater diagonal of the prism; namely, parallel to the plane *f*, of the following figure. Specific gravity 3.3.—3.4. It consists of arsenic 62, sulphur 38. Klaproth. Before the blow-pipe its effects are the same as those of realgar.



M on M	100°. 0′
M ou *c* or M on *c*′	120? 0
M or M′ on *f*	140°. 0
———— *g*	177 .54
M′ on *i*	162 .38
c on *c*′	83 .30
—— *b*	145 .50

The rare crystals represented by the preceding figure, were presented to me by S. L. Kent, Esq.

It occurs both in primitive and secondary rocks. In granite at Wittichen in Suabia, with red silver; in veins of calcareous spar at Lucerno in Piedmont; at Moldavia in Hungary in a vein of pyritous copper; in ferruginous clay at Thajoba; also at Transylvania, Georgia, &c. and in China, and Mexico: on the north-west coast of America intermixed with realgar.

* Whence Orpiment, from the Greek, signifying gold-yellow.

COBALT.[*]

It is not found in the native state; it ores are not very numerous.

ARSENICAL COBALT.

Of this there are three varieties.

1. BRIGHT WHITE COBALT.

Glanz Kobold W. Cobalt gris H. Bt. Cobalt éclatant Br. Bright white Cobalt, Kirwan, A.

Its colour is silver or sometimes yellowish white, with a tinge of red. It occurs in the form of the cube and its varieties; its crystalline forms precisely resemble those of iron pyrites; the planes of the cubes are generally striated: the structure is lamellar, it yields readily to mechanical division parallel with all the planes of a cube, which therefore is the form of its primary crystal; the cross fracture is fine grained; it also occurs arborescent, stalactitic, botryoidal, and amorphous; it yields with difficulty to the knife, and is not very frangible. Specific gravity 6.3—6.5. That of Tunaberg consists of 44 cobalt, 55 arsenic, 0.50 sulphur. Klaproth. Before the blow-pipe on charcoal it first becomes black, then as it gets red-hot disengages arsenical fumes, and melts into a metallic globule of a dull black externally, which attracts the magnetic needle, and tinges borax of a deep blue.

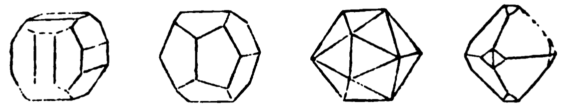


Fig. 1. The primary; a cube. Fig. 2. The same, of which the solid angles are replaced by triangular planes; which in fig. 3, are so greatly

ied as to reduce the primary planes to small squares; and are ete in fig. 4, the regular octohedron. Fig. 5. The cube; of which dge is replaced by an irregularly six-sided plane, alternately placed erent directions. In fig. 6. these planes are complete, forming the onal dodecahedron. In 7 fig. they are in connection with the planes octohedron, which are increased in fig. 8; reducing the irregularly ed planes of fig. 5, to small triangles.

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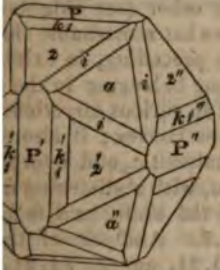
[*] Cobalt, from the German, meaning an injurious substance; from the inconvenience to which the accompanying arsenic subjects the miner.



P on P′ or P″	90°.00′.00″.00‴	H
a on *a*′ or *a*″	109 .28.16. 00	..
PP′ or P″ on *a*......	125 .15.52. 00	..
P on *k*1, P′ on *k* 1′ or P″ on *k* 2″..	166 .30.00. 00	
P on *k*2, P′ on *k*2′ or P″ on *k*2″ ...	153 .26. 5. 30	H
a or *a*′ on *k*2........	140 .46.17. 00	..
a on *i*	163 .27.00. 00	
*k*2′ on *k* 2′	126 .52.11. 00	H

occurs in the veins of primitive mountains, and sometimes lded in rocks; as in mica-slate and gneiss.

s found in Norway, at Tunaberg in Sweden, and at Queerin Silesia; chiefly in Norway and Sweden.

e Cobalt or smalt of Commerce is chiefly obtained from it.

2. GREY COBALT.

6.1.11

11(

r Spieskobold W. Var. de Cobalt arsenical H. Grey Cobalt J. A.

occurs of a greyish black colour externally: internally, fresh fractured, it is of a steel-grey colour and metallic ; it is found amorphous, in curved lamellar concretions, stalactites, never crystallized; the fracture is even, or flat oidal, sometimes with a granular appearance; it is hard rittle. Specific gravity 5.5. Analysis of that of Skutterud orway, cobalt 33.10, arsenic 43.47, iron 3.02, sulphur . Stromeyer.

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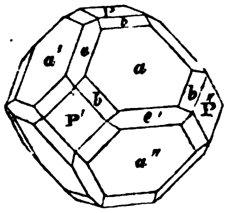
ce the preceding variety it occurs in primitive rocks, and etimes found, but is less abundant, in Sweden and Norit also occurs in Bohemia, Saxony, Silesia, Hungary, e, &c. At Chatham in Connecticut, North America, in nblende rock.

Cornwall, it was found in the copper veins of Dolcoath; cross veins of Herland, accompanying native silver, &c.; ith bismuth in Huel Sparnon near Redruth.

3. TIN-WHITE COBALT.

Weisser Spieskobold W. Var. de Cobalt arsenical H. Tin white Cobalt J.
Arsenical Cobalt A.

It occurs of a tin-white, but is sometimes tarnished externally; it is found in cubes, octohedrons, and in crystals which form the passage of the one into the other (see Bright-white Cobalt, fig. 1, 2, 3, 4); but it is somewhat remarkable that the crystals of this variety differ from the preceding, in exhibiting only the regular planes of modification, belonging to the cube. The crystals are often cracked or rent in various directions, and their planes are commonly more or less convex; it also occurs arborescent, reticulated, botryoidal, stalactitic, and amorphous; the fracture is fine-grained and uneven, with a glistening metallic lustre; it yields with difficulty to the knife, and is brittle and hard. Specific gravity 7.3—7.7. Analysis of that of Riegelsdorf by Stromeyer, cobalt 20.31, arsenic 74.21, iron 3.42, copper 0.15, sulphur 0.88. Before the blow-pipe on charcoal it gives out a copious arsenical vapour on the first impression of the heat; it melts only partially, and that with great difficulty, and is not attractable by the magnet; on the addition of borax it immediately melts into a grey metallic globule, colouring the borax of a deep blue.



P on P′ or P″	90°00′
P P′ or P″ on *a*	125.16
P on *b*, P′ on *b*, or P″ on *b*	155.10
P or P′ on *e*, or P′ or P″ on *e*′	135. 5
a on *a*′ or *a*″	109.28
a on *b*, *b*, or *b*	151.30
a or *a*′ on *e*, or *a* or *a*″ on *e*′	144.55
e on *e*′	120.00

It occurs chiefly in primitive rocks, but is also found in transition, and accompanies the other ores of cobalt, also bismuth.

It is found in Cornwall, but not crystallized, in the same places and under the same circumstances as grey cobalt. It also occurs in several European countries.

SULPHURET OF COBALT.

Cobalt sulfuré, Lucas.

It is whitish with a tinge of yellow, or of a steel-grey colour, massive, with an uneven fracture, presenting a granular surface; and it is described as occurring botryoidal, and externally brilliant. Analysis by Hisinger, cobalt 43.2, sulphur 38.5, copper 14.4, iron 3.53, earthy ingredients 0.33. On charcoal alone before the blow-pipe it fuses after roasting into a grey metallic globule, from which it is difficult to drive off the last portions of sulphur; with the fluxes the effects of the cobalt predominate so much that it is impossible to distinguish those of iron or copper.

It is found according to Berzelius at Bastnaes near Riddarhytta in Sweden.

EARTHY COBALT.

Erdkobold W. Cobalt oxydé H. Cobalt ochre J. Earthy Cobalt A.

It is of various shades of yellow, brown, bluish-black, and black, and occurs massive, mamillary, botryoidal, investing and pulverulent; the fracture of the massive is earthy, and it is dull, but acquires a polish by friction, and it yields easily to the knife. Specific gravity 2—2.4. It is generally supposed to CCCXL consist of oxide of cobalt, rendered more or less impure, by the admixture of arsenic, iron, &c. Before the blow-pipe on charcoal it exhales a slight arsenical odour, but does not fuse; with borax it fuses of a deep cobalt blue colour.

It occurs chiefly in secondary rocks, and is sometimes accompanied by ores of iron, silver, and copper.

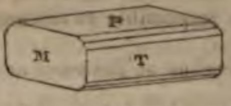
It is found in Hesse, Saxony, Bohemia, Suabia, the Tyrol, Austria, France, and Spain.

In England, the black variety occurs in sandstone, with yellow copper, at Alderley Edge, in Cheshire; also, it is said, in Huel Unity near St. Day, and in the Wherry mine, Mount's Bay in Cornwall. In Ireland, of a blue colour, investing fissures in slate-clay in the peninsula of Howth near Dublin.

RED COBALT. COBALT BLOOM. ARSENIATE OF COBALT.

Rother Erdkobold W. Cobalt arseniaté H. Red Cobalt ochre J.

It occurs whitish or greyish-white, also of various shades of red passing into crimson. It is found in small botryoidal masses, also investing, and in short acicular diverging prisms modified on the edges: the form of the crystal appears, by the reflective goniometer, to be a right oblique-angled prism. The crystals CCCXXV which possess most nearly the characters of regular form are translucent and shining, the other varieties are glimmering or (4 dull, and nearly opaque; it is soft, light, and flexible. It consists of cobalt 39, arsenic acid 30, water 23. Bucholz. Before the blow-pipe on charcoal it fumes abundantly, emitting an arsenical odour, and tinges borax blue.



For the above figure and measurement I am indebted to H. J. Brooke, Esq.

It occurs in primitive and secondary rocks, with the other ores of cobalt; with some of those of nickel, copper, iron, and lead, and is found in most European countries.

In Cornwall, it occurs investing grey cobalt at Botallack near the Land's End; in Dolcoath mine, and in Huel Sparnon; near Redruth on arsenical cobalt, and in Polgooth mine near St. Austle; in Devonshire on grey cobalt in Willsworthy mine. In Scotland with native and grey silver formerly in Alva Stirlingshire; in small veins in the limestone of the Coal formation in Linlithgowshire; with galena and blende in the sandstone of the Coal formation at Broughton near Edinburgh: in Clifton lead mines near Tyndrum. In Ireland, on the surface of a bed of talc-slate in the mica-slate of the eastern parts of that country.

RED VITRIOL. SULPHATE OF COBALT.

It is of a pale rose red colour, and occurs investing other minerals, in small masses, and in stalactites; the masses are semi-transparent and crystalline; its taste is styptic. It consists of oxide of cobalt 38.71, sulphuric acid 19.74, water 41.55. Koppe. Its solution affords, with carbonate of potash, a pale bluish precipitate, which tinges borax of a pale blue colour.

It occurs in the mining heaps in Bebèr, with lamellar heavy spar, earthy and grey cobalt; also in the Leogang.

CXLVIII *Cobaltiferous. Sulph. nate of Magnesia*
120.

NICKEL.

The ores of Nickel are few and not abundant.

NATIVE NICKEL.

LXVI
121

Haarkies W. Nickel natif H.

It occurs in capillary and sometimes diverging filaments of a yellowish colour, inclining to steel-grey. It is flexible; but is not magnetic. It consists, according to Klaproth, of nickel, with a small quantity of cobalt and arsenic; the presence of the latter is supposed to be the cause of its not affecting the magnetic needle. Before the blow-pipe on charcoal with a good heat, it semi-fuses into an agglutinated mass, which is metallic, malleable, and magnetic, and consists wholly of nickel; but in the open tube it exhales the odour of sulphurous acid.

It is found in Saxony, Bohemia, near Salzburg, and in the Hartz.

In Cornwall, it has been found in the cavities of copper nickel in Huel Chance mine near St. Austle.

COPPER NICKEL. ARSENICAL NICKEL.

Kupfernickel W. Nickel arsenical H. Bt. Copper Nickel J. A.

It is of a copper red, or yellowish red of various shades, but acquires a grey or blackish tarnish by exposure. It occurs reticulated, dendritic, and botryoidal, but more commonly massive; it is said to have occurred in six-sided prisms. The fracture is imperfectly conchoidal, or fine-grained and uneven, with a glistening or shining metallic lustre; it yields to the knife with difficulty, and is brittle. Specific gravity 6.6—7.5. That of Riegelsdorf in Hesse consists, according to Stromeyer, of 44.2 of nickel, with a slight admixture of cobalt, and 54.7 of arsenic, iron 0.3, lead 0.3, and sulphur 0.4. A specimen from Allemont, in Dauphiné, analysed by Berthier, yielded arseniuret of Nickel 88.55, arseniate of cobalt 00.35, sulphuret of antimony 10.00, iron and manganese a trace. Before the blowpipe it gives out an arsenical vapour, and then fuses, though not very easily, into a dark scoria mixed with metallic grains.

Ɛ⊥X|X
/2

It generally occurs in primitive rocks; but is also found in secondary rocks. It usually accompanies the ores of cobalt, silver and copper.

It is found in the veins of primitive rocks in Saxony, Bohemia, France, and the Bannat: in transition rocks in the Hartz: it is also found in Suabia, Salzburg, and Spain.

It occurs in the copper mines of Frederick county, North America; at Chatham in Connecticut it accompanies cobalt.

In Cornwall it occurs in Pengelly mine; in Huel Chance mine with native nickel and nickel ochre. In Scotland, in the lead mines of the lead hills and Wanlock head: in veins with nickel ochre, galena, and blende, in the limestone of the coal-field of Linlithgowshire.

ARSENIATE OF NICKEL. NICKEL OCHRE.

Nickel ocher W. Nickel Oxidé H. Bt. Nickel Arseniaté. Berthier.

This substance is found adhering to or coating arsenical nickel, and is considered to be derived from its spontaneous decomposition. It is sometimes compact, of a very fine apple-green colour; sometimes friable and of a greenish white colour. By calcination it assumes the yellowish colour of goose dung; and loses somewhat less than a fourth part of its weight of water without giving out any odour. It dissolves readily and completely in acids, even when cold, and without effervescence. The greenish white variety, analysed by Berthier, yielded arseniate of nickel 70.6, arseniate of cobalt 04.9, water 24.5, ferruginous argil a trace. Before the blow-pipe on charcoal it exhales a strong odour of arsenic; in the interior flame it fuses into a globule of arseniferous nickel.

It is found adhering to the arsenical nickel of Allemont.

In Scotland it is found with copper nickel in the lead hills and Wanlock head; at Alva in Stirlingshire, and in a lead vein in limestone, in the Hilderstone hills, Linlithgowshire. In Cornwall, in Pengelly and Huel Chance, investing Copper nickel.

PIMELITE.

Pimelit W. Br. Nickel oxydé Bt. Pimelite J.

LXVI
124

It is of an apple-green or yellowish-green colour, and occurs investing other minerals, and massive; it is earthy and dull, or glimmering, soft, and greasy to the feel. It consists of oxide of nickel 15.62, silex 35, alumine 5.10, lime 0.40, magnesia 1.25, water 37.91. Klaproth. It is infusible before the blow-pipe, but loses part of its weight, and assumes a dark grey colour.

It occurs in Kosemütz, Grachau, and Glassendorf in Silesia, in veins traversing serpentine, and is associated with chrysoprase, of which nickel is supposed to be the colouring matter.

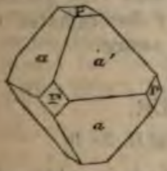
SILVER.

Silver occurs in the native state, and its ores are numerous; in some of them it is combined with other metallic substances in various proportion; but occasionally the proportion of silver is so small, that the ore ought not to be ranked among those of silver, a rank which it has obtained because silver is the most precious of its ingredients; it is also found united with sulphur, and with some of the acids.

NATIVE SILVER.

Gediegen Silber W. Argent Natif H. Br. Bt.

It is of a pure white, with a shining metallic lustre, but is generally tarnished externally of a greyish black colour, pro- §. CLVII
bably owing to the presence of a small quantity of sulphur. It (125
occurs in small grains, massive, and crystallized in the cube and regular octohedron, but as native silver does not possess a lamellar structure, either of those solids may be considered as the form of its primary crystal; in the following figure the cube is assumed, as being the most simple; it also occurs capillary, ra- CCCXXVI
mose, and reticulated, but a close inspection will discover by the assistance of a lens, that these varieties consist of elongated crys- (41
tals, or of minute crystals in the form of the cube or octohedron, closely aggregated. It is soft, but harder than gold; also flexible and malleable. Specific gravity about 10. That of Johan- XVI
georgenstadt consists of metallic silver 99, metallic antimony 1, (41
together with a trace of copper and arsenic. John. It is rarely perfectly free from some admixture of other metals, which is supposed to be the cause of its being less malleable than pure silver. It is fusible before the blow-pipe into a globule which is not altered by a continuance of heat.



P on P or P	.. 90°00'00"	H
P on *a* or *a'*	.. 125.15.52"	..
a' on *a* or *a*	.. 109.28.16"	..

It occurs in primitive, transition and flœtz rocks, occasionally associated with some of the ores of silver, arsenic, cobalt, bismuth, copper and iron.

In granite in the Saxon Erzgebirge and Suabia; in gneiss and mica slate, in Saxony, Bohemia, and Norway; in greywacké in the Hartz. It is found most abundantly in the mines of South America.

In Cornwall it has been found in several mines, principally in north and south veins, and only in clay-slate. In Herland mine imbedded in a soft marle, and accompanied by sulphuret of lead, arsenical cobalt, quartz, &c.; in Huel Mexico, in Perran Zabuloe, with argentiferous galena: with grey silver in Dolcoath; in Huel Duchy near Callington, with red, grey, and black silver: in Huel Alfred in Gwinear, in green carbonate of copper: in Huel Ann in Phillack, with grey silver and arsenical pyrites: in Willsworthy mine on the borders of Devon, with arsenical cobalt and yellow copper; with muriate of silver in

Huel St. Vincent near Calstock. Herland and Huel Basset were the richest silver mines of Cornwall: the former yielded about 8000l. worth of ore, the latter to the amount of 3000l.; their principal ores were, I believe, of the vitreous kind.

In Scotland, in floetz clay-porphyry at Alva in the Ochil hills, and in other districts, according to Jameson, in limestone, sandstone, clay-stone, and slate-clay, and accompanied several of the ores of silver, arsenic, cobalt, bismuth, lead, zinc, &c. It is said that 40 or 50,000l. worth of silver were yielded by the mine at Alva, in the Ochil hills.

In Ireland, native silver is said to have been found in clay-slate.

1. AURIFEROUS NATIVE SILVER.

Guldisches gediegen silber W. Argent natif aurifère Br.

It is of a colour between silver-white and brass yellow; it occurs disseminated, capillary, and crystallized in cubes. Its specific gravity is greater than that of native silver. A specimen analysed by Dr. Fordyce, yielded silver 72, gold 28.

It occurs in veins in primitive rocks at Kongsberg in Norway, at Rauris in Salzburg, and at Schlangenberg in Siberia.

In Cronebane in Ireland, a metalliferous vein includes a brown iron-stone which encloses minutely disseminated native silver, containing 30 grains of gold in the ounce.

ANTIMONIAL SILVER.

Spiesglassilber W. Argent Antimonial H. Br. Bt.

XLIX
126

It is of a colour between silver-white and tin-white, but is often tarnished yellowish or reddish, externally. It mostly occurs massive, or in grains, but has been observed in crystals which appeared to be six-sided prisms, but of which the faces were somewhat convex, and deeply striated longitudinally; the Comte de Bournon does not consider the form of the crystal to be a regular six-sided prism. The structure is lamellar with a shining metallic lustre, and the cross fracture is flat conchoidal; it is easily frangible, soft, and possesses a slight degree of malleability. Specific gravity 9.4—9.8. A finely granular variety from Wolfatch yielded silver 84, antimony 16: Klaproth. But the proportion of antimony varies in several analyses, from 11 to 25 per cent. Before the blow-pipe on charcoal it melts into a globule, and the antimony flies off in white vapour, leaving finally a bead of pure silver.

It occurs in veins traversing granite, greywacké, and clay-slate, and is accompanied by other ores of silver, and those of arsenic, lead, zinc, and antimony.

In granite at Vitticben and Altwolfatch in Suabia, in clay-slate at Andreasberg in the Hartz: it is also found at Casalla near Guadalcanal in Spain, in Gaslein, in Salzburg, and at Allemont in France.

1. ARSENICAL ANTIMONIAL SILVER.

Arseniksilber W. Argent antimonial ferro-arsenifère H. Argent Arsenical Br. Bt.

It is nearly of the colour of native silver, but is commonly tarnished externally of a blackish colour; it occurs in small globular and reniform masses, and sometimes investing other substances; the structure is lamellar, with a shining or glimmering metallic lustre. It is harder than antimonial silver, but is sectile, brittle, easily frangible, and heavy. That of Andreasberg consists of silver 12.75, arsenic 35, iron 44.25, antimony 4. Before the blow-pipe the arsenic and antimony are for the most part volatilized, leaving a globule of impure silver surrounded by a slag.

Its localities and associations are nearly the same as those of antimonial silver. It occurs deposited on arsenic at Andreasberg in the Hartz.

It is said to have been found in Herland mine in Cornwall, with native silver, galena, &c.

MOLYBDIC SILVER.

Molybdan Silber, Werner.

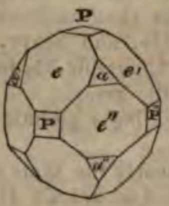
This mineral is described by Leonhard. It is of a light steel-grey passing into tin-white, but occasionally inclining to lead-grey, with a metallic aspect, and occurs in crystalline masses, or in crystals in the form of a six-sided prism, which are divisible into thin laminæ parallel to the terminal planes, but not quite so easily as mica. It is somewhat soft, and elastic, and when reduced to powder is of an iron-black. Specific gravity 7.82. Before the blow-pipe on charcoal, it melts on the first impression of the point of the flame, into small globules, which become of a yellow colour and somewhat tarnished. Klaproth analysed a mineral under the name of Molybdan Silber which he found to consist of bismuth 95, and sulphur 5, on which it is remarked by Leonhard, that it can scarcely be doubted that the mineral so analysed, was not that which is above described.

It occurs with brown spar and iron-flint at Pilsen in Hungary.

SULPHURET OF SILVER. VITREOUS SILVER.

Glaserz W. Argent sulfurè, H. Bt. Argent Vitreuse Br.
Silver glance J.

XXXII 127 It is of a dark lead-grey colour, but often has a superficial irridescent tarnish; it occurs in the form of the cube parallel to the planes of which it yields to mechanical division; it also is found in the forms of the regular octohedron, and rhombic dodecahedron; the cross fracture is fine-grained and uneven, sometimes small and flat conchoidal, with a more or less shining metallic lustre; it is soft and very malleable. Specific gravity about 7. A specimen from Himmelsfürst, analysed by Klaproth, yielded silver 85, sulphur 15; but in four analyses the quantity of sulphur varied from 15 to 25. Before the blowpipe the sulphur flies off, and a bead of pure silver remains.



P on P′ or P″ ……	90°.00′.00″	H
PP′ or P″ on *a* …	125 15 .52	..
P or P′ on *e*………	135 00 .00	..
a on *a*′ or *a*″ …….	109 28 .16	..
a or *a*′ on *e*, or *a* or *a*″ on *e*″..	…144 44 . 8	..
e on *e*′ or *e*″ …….	120 00 .00	..

It occurs in veins in primitive and transition rocks, and is associated with the ores of silver, copper, lead, iron, cobalt and arsenic

It occurs in veins traversing granite at Altwolfach in Suabia; in gneiss in Saxony; in mica-slate and clayslate at Joachimsthal in Bohemia; in greywacké in the Hartz; in limestone at Annaberg in Lower Austria; and is found in other countries.

XLV (418) In Cornwall, it occurred both massive and in cubes in the cross vein of Herland; with red and native silver in that of Huel Duchy; in cubes in Huel St. Vincent near Callington; in Huel Basset with galena; it also occurred in a copper vein in Dolcoath mine.

1. BLACK SULPHURET OF SILVER.

Silberschwarze W. Earthy Silver Glance J.

It is of a dark lead grey, inclining to black, and is without lustre or only feebly glimmering; it occurs massive and pulverulent, sometimes investing other ores of silver and filling up cavities in them; the fracture of the massive is uneven, it is more or less sectile, and it gives a shining metallic streak. Be-

the blow-pipe it is readily converted into a slaggy mass con-
ing globules of impure silver.

occurs in the veins of primitive mountains with other ores
lver, and with native gold.

is found in the Saxon Erzgebirge, at Kremnitz and Schem-
; in Chalanches near Allemont in Dauphiné; at Kongsberg
orway, and at Schlangenberg in Siberia.

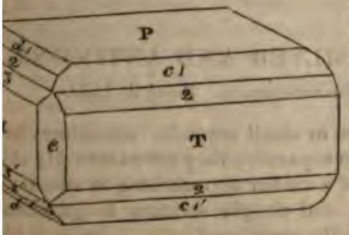
Cornwall it occurred in the cross veins of Herland mine,
in Huel Duchy.

FLEXIBLE SULPHURET OF SILVER.

Argent sulfuré flexible. Bournon.

is externally of a dark colour, approaching to black, and oc-
both massive and in small tabular crystals, much resembling
nbic prisms of 120° & 60°, modified on the edges, which
are considered to be by the Comte de Bournon, who first
ribed this mineral: by the assistance of the reflective
ometer however, it has been ascertained that the form of
crystal is a right oblique-angled prism, whose lateral planes
alternately 125° & 55°, and whose proportions differ from
e of the rhombic prism only in having one pair of its oppo-
lateral planes of different dimension to the other pair: the
tals are often even minute and very flat, and are then ex-
lely flexible, but are separated readily into thin laminæ
llel with the terminal planes: it is very soft, yielding
ily to the knife, affording a surface with a metallic lustre,
less brilliant than that of sulphuret of silver. The relative
ortions of its ingredients have not been ascertained, but it
ted by Bournon in his 'Catalogue,' that the experiments
Ir. Wollaston proved it to consist of silver, sulphur, and
traces of iron.

&. Cl. XII
123



M on T	125°.00′
P on M or T	90 .00
—— c1	134 .45
—— c2	111 .30
—— *d*2	138 .15
—— *d*3	119 .15
M on *d*1 or *d*1′	114 .00
—— *d*2 or *d*2′	131 .45
—— *d*3 or *d*3	150 .30
—— *e*	146 .10
T on c1 or c1′	135 .00
—— c2	153 .20
—— *e*	159 .00

r the preceding figure and measurements I am indebted to H. J.
ke, Esq.

The locality of this mineral is not precisely known: the Comte de Bournon suspected that his own specimens were from Hungary; the gangue was a flesh-coloured and martial carbonate of lime, mixed with grey copper and sulphuret of iron, and lenticular crystals of carbonate of lime. The crystal above figured is from Himmelsfurst in Saxony.

BRITTLE SULPHURET OF SILVER.

Spröd Glaserz W. Argent antimonié sulfuré noir H. Br.
Brittle Silver Glance J.

It is described by the Comte de Bournon in his 'Catalogue,' as being of a dark lead or bluish-grey, passing into iron-black; when pulverized, dark-grey or brownish; and as occurring generally in low hexahedral prisms, of which the terminal edges are sometimes replaced, and occasionally all the edges are rounded, producing the lenticular form; the crystals mostly intercept each other; it also occurs massive and disseminated. Externally it varies from splendent to dull; the structure is sometimes distinctly lamellar, but the fracture is commonly somewhat conchoidal with a shining metallic lustre; it is soft, and brittle. Specific gravity 7. A specimen from near Freyberg, yielded 66.5 silver, 10 antimony, 12 sulphur, 5 iron, 0.5 copper and arsenic, 1 earthy impurities. Klaproth. Before the blow-pipe it melts, the sulphur, antimony, and arsenic fly off, and there remains a bead of brittle silver surrounded by a slag.

It occurs principally in veins traversing primitive rocks, as gneiss and clay-slate, and is associated with most of the other ores of silver, and with some of those of lead, zinc, iron and copper.

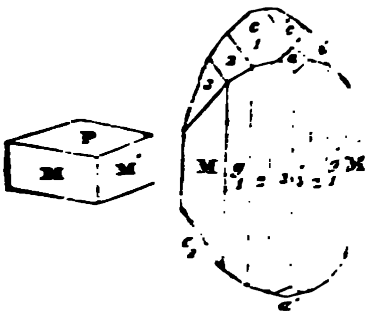
It is said to occur near Freyberg in Saxony; in Bohemia; at Cremnitz, and Chemnitz in Hungary; in Siberia; in Mexico and Peru.

SULPHURET OF SILVER AND ANTIMONY.

Mine d'argent grise antimoniale. Romé de Lisle.

XCVII
129

This rare mineral occurs in small crystals, sometimes irregularly associated, more often separate; they are externally shining and even splendent, and of a colour approaching to silver-white. The crystals are minute and deeply striated longitudinally; the striæ however are for the most part only a series of planes modifying the obtuse edges of the prism, as in the following figure: they are extremely brittle, yielding readily to mechanical division parallel to the planes of a right rhombic prism of 100° & 80°, by the reflective goniometer, from planes of cleavage, and probably also in other directions. Specific gravity 5.5. Before the blow-pipe it gives off copious white vapours, accompanied by a slight sulphureous odour, leaving ultimately a small white bead, apparently of silver.



M on M'	100° .00
M or M' on *a* or *a'*	135 .15
M on c1 or M' on c1'	110 .00
—— *g*1 or —— *g*1'	170 .10
—— *g*2 or —— *g*2'	160 .30
—— *g*3 or —— *g*3'	146 .30
a on c1 or c1'	120 .12
c1 on c1'	130 . 8
—— c2	145 .24
—— c3	143 .25
c3 on c3	122 .15

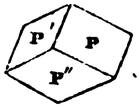
It was found at the Himmelsfurst mine at Freyberg in Saxony, generally deposited on carbonate of iron, and accompanied by blende and galena, on a quartzose gangue. According to Romé de Lisle, this mineral, together with a plumose antimony, supposed to arise from its decomposition, yielded seven to eight marcs of silver per quintal, the remainder being antimony mineralised by sulphur.

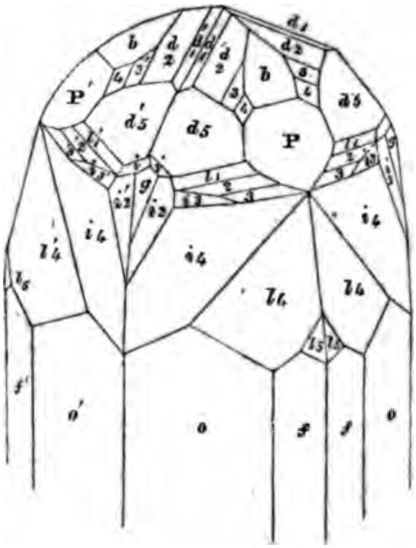
RED SILVER. RUBY SILVER.

Rothgültigerz W. Argent antimonié sulfuré H. Argent rouge Br. Br.

It varies by reflected light from lead-grey to iron-black, by transmitted light from brilliant to dark red; it occurs crystallized in a great variety of forms, also dendritic, massive, and micaceous; the structure is lamellar; it is mechanically divisible into the form of an obtuse rhomboid, of [illegible]; being the primary form of its crystals; but the extreme brittleness of this substance renders it very difficult to obtain the natural joints; it may also be cleaved in other directions which have not been ascertained: the cross fracture is imperfectly or perfectly conchoidal, with a shining lustre; it yields easily to the knife. Specific gravity about [illegible]. It contains according to Klaproth, of silver [illegible], antimony [illegible], sulphur [illegible]; [illegible]; or, according to Thenard, of [illegible] of silver, [illegible] of antimony, 16 of sulphur. Before the blow-pipe [illegible] it first decrepitates, fuses, burns and fumes like antimony, but does not give off any smell of arsenic, leaving behind a globule of silver.

Primary..





The above figure represents a crystal in the possession of H. J. Brooke, Esq. who permitted me to measure it by means of the reflective goniometer. This crystal, perhaps one of the most complex that has been observed, tends to confirm the observation already annexed to the rhomboidal figure accompanying the notice of Calcareous Spar—viz. that the modifications to which the rhomboid is liable, are almost endless. The planes *b* of the above figure tend, by their extension, to produce a rhomboid more obtuse than the primary, the planes *g* to acute rhomboids: the planes *d* 1, 2, 3, 4, and 5, to the production of obtuse dodecahedrons; all the planes *i* and *l* to acute dodecahedrons; *o o* and *f f* to regular six-sided prisms.

P on P′	108°30′	*i*2 on *i*2′	157°20′
— — *b*	172. 0 c.g.	— — *g*	168.10
— — *d*1 or P′ on *d*1′	164.15	*i*3 on *i*3	151.15
— — *d*2 or —— *d*2′	167.43	*i*4 on *i*4	134.40
— — *i*4 or —— *i*4′	141.50	*l*1 on *l*2	178.50
— — *l*3 or —— *l*3′	163. 0	*l*2 on *l*3	179. 0
— — *l*4 or —— *l*4′	158.22	*l*2 on *l*2	148.32
— — *o* or —— *o*′	126.10	*l*3 on *l*3	153.17
*d*2 on *d*2	164.50	*l*4 on *l*4	141.20
— — *d*2′	132.55	*l*5 on *l*5	173.30
*d*5 on *d*5	155. 0 c.g.	*o* on *o* or *o*′	120. 0
*d*5 on *d*5′	125. 0 ..		

It occurs in veins traversing gneiss, mica-slate, porphyry, and greywacké, and is accompanied by some of the other ores of silver, and some of those of lead, iron, and copper.

It occurs in Saxony, Bohemia, Hungary, Transylvania, Norway, in the Hartz, in Spain, but more abundantly in Mexico and Peru.

In Cornwall, it occurred in a cross vein in Huel Duchy mine, both massive and crystallized, accompanied by native silver and black silver.

SULPHURET OF SILVER AND COPPER.

Argent et cuivre sulfuré, Bournon. Silberkupferglanz Stromeyer.

This mineral is described by the Comte de Bournon, as being of a deep grey colour with a shining lustre; the surface [produced by fracture] being very brilliant, granular, and partially conchoidal; it is very brittle, and readily fusible before the blow-pipe: it had not been analysed when described by Bournon, but he cites the authority of Dr. Wollaston for considering it as consisting only of silver, copper, and sulphur. It was transmitted from St. Petersburg by Sir Alexander Crichton, and was found in the mines of Culivan in Siberia.

A specimen from Schlangenberg in Siberia, analysed by Stromeyer, consisted of sulphuret of silver 60.65, sulphuret of copper 38.65, sulphuret of iron, 0.70. It is described as being of a colour between lead-grey and iron black, with a tinge of red. Specific gravity 6.25.

WHITE SILVER.

Weissgültigurz W. Plomb sulfuré antimonifère et argentifère H.
Argent blanc Br.

This mineral varies much in its characters: its general colour is a light lead grey, which occasionally inclines to black: it occurs massive and disseminated, and is often associated with cubic galena: the fracture is even and fine grained, with a glistening metallic lustre, sometimes uneven, when passing into sulphuretted silver; sometimes fibrous, when passing into plumose antimony; it is soft and somewhat brittle. Specific gravity 5.3. One variety of a light-grey colour from Himmelsfurst near Freyberg, afforded 20.40 silver, 48.06 lead, 7.88 antimony, 2.25 iron, 12.25 sulphur, 7.0 alumine, 0.25 silex, Klaproth; another variety of a dark-grey afforded the same ingredients, varying a little in their proportions. Before the blow-pipe it melts and partly evaporates, leaving a bead of impure silver, surrounded by a yellow powder.

It has been found chiefly in veins traversing gneiss, and is accompanied by other ores of silver, and some of those of antimony and iron.

It occurs chiefly in certain mines near Freyberg in Saxony, but is said to have been found in the Hartz and in Bohemia; it is also found in Peru.

This and the following variety, as is manifest from their composition, ought not to be arranged among the ores of silver: Haüy has transferred this to those of lead, with which they both probably rank.

BISMUTHIC SILVER ORE.

Wissmuth Silbererz, Selb. Bismuthic Silver J. A.

It is of a light lead-grey colour, but becomes of a deeper colour by exposure; it occurs disseminated, rarely massive, or acicular; the fracture is fine grained and uneven, with a glistening metallic lustre: it is soft, sectile, and somewhat brittle. It consists of silver 15, bismuth 27, lead 33, iron 4.30, copper 0.90, sulphur 16.30. Klaproth. Before the blow-pipe metallic globules begin to ooze out, and on the addition of borax, unite into one mass, the flux at the same time acquiring an amber colour; the metallic button is brittle, and of a tin-white colour.

It has been found only in one mine in gneiss, in the Black Forest, accompanied by copper and iron pyrites and galena.

SELENIURET OF SILVER AND COPPER.

Eukairite,[*] Berzelius.

CL 11
131

This newly discovered mineral is described as being of a shining lead grey colour, with a granular texture; as yielding readily to the knife, producing a surface which has the lustre of silver. It consists according to Berzelius of silver 38.93, copper 23.05, selenium 26.00, other substances 8.90, and may in his opinion be considered as a compound of seleniuret of silver and of copper. Before the blow-pipe it melts, exhaling a strong odour like that of horse-radish, leaving a small grey metallic globule.

It occurs in a copper mine at Skrickerum in Smoland, Sweden, with carbonate of lime, seleniuret of copper, and copper pyrites.

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[*] Eukairite, from the Greek, signifying opportune; in allusion to its discovery just as Berzelius had completed his examination of Selenium.

CARBONATE OF SILVER.

Argent carbonaté H. Grey Silver ore J. Carbonated Silver A.

It is of a greyish colour passing into iron black; it occurs massive and disseminated; the fracture is fine grained and somewhat uneven, with a glistening metallic lustre; it is soft, brittle, and heavy. It consists of silver 72.5, carbonic acid 12, oxide of antimony and a trace of copper 15.5: Selb. It is easily reduced before the blow-pipe; and effervesces with nitrous acid.

It occurs in veins traversing granite in a mine at Altwolfatch in the Black Forest, and is accompanied by native silver and sulphuret of silver.

MURIATE OF SILVER. HORN SILVER.

Hornerz W. Argent muriaté H. Bt. La mine corné Br. Corneous Silver ore J. Horn Silver A.

It is of a pearl-grey, greenish or reddish blue, or of a brown colour, but is commonly tarnished externally of a brown colour; it occurs massive, also investing other substances, and crystallized in small cubes and acicular prisms; it is translucent or opaque, with a glistening or waxy lustre; it is very soft, yields to the pressure of the nail, and is malleable and sectile. Specific gravity 4.8. A massive specimen yielded 88.7 muriate of silver, 6 oxide of iron, 1.75 alumine, 0.25 sulphuric acid: Klaproth. It is fusible in the flame of a candle; before the blow-pipe on charcoal it is reducible to a metallic globule, giving out at the same time vapours of muriatic acid: when rubbed with a piece of moistened zinc, the surface becomes covered with a thin film of metallic silver.

CCXLIV
(419

It occurs in veins chiefly in primitive rocks, with some of the other ores of silver, and some of the ores of lead and copper, rarely with gold.

It is found in Saxony, Hungary, France, and in Siberia; but is most abundant in some of the silver mines of Potosi in South America.

In Cornwall, it occurred both massive and in cubes in Huel Mexico, and with native silver in Huel St. Vincent mine near Calstock.

1. BUTTERMILK SILVER.

Buttermilch Silber W. Earthy Corneous Silver J. Buttermilk Silver A.

It is described as being of a brownish-white, sometimes with a tinge of green, externally bluish-grey or slate-blue; it is said to have occurred in veins and cavities in a fluid state, whence the name of Buttermilk silver, but is commonly found massive and investing other substances. It is opaque, and dull with an earthy fracture, and is soft, sectile, and heavy. It consists of silver 24.64, muriatic acid 8.28, alumine with a trace of copper 67.08. Before the blow-pipe on charcoal it feebly agglutinates, and minute globules of silver appear oozing through the mass.

It occurred only in veins traversing transition rocks at Andreasberg in the Hartz.

COPPER.

Copper is found in the native state; its ores are numerous and highly interesting.

NATIVE COPPER.

XVI Gedeigen Kupfer W. Cuivre natif H. Br. Bt.

/420/ It is nearly of the colour of purified copper, frequently with
a tinge of brown; it is often tarnished externally yellowish or
XV (421) blackish, sometimes with a tinge of red: it occurs crystallized
in the form both of the cube and octohedron, but the crystals,
CLXXV which are very numerous, are more often macles or hemitrope
(422) crystals; it also occurs capillary, dendritic, in thin plates filling
up crevices, and massive: it does not possess any regular struc-
VII (423) ture; the cube is adopted as its primary form, as being the
most simple figure in which it occurs: it is moderately soft,
very tough, malleable, flexible, and sectile. Specific gravity
7.7—8.5. That of Ekaterineburg consisted according to the
analysis of John, of pure copper 99.80 with a trace of gold and
iron. Before the blow-pipe it fuses into a bead of apparently
pure copper.

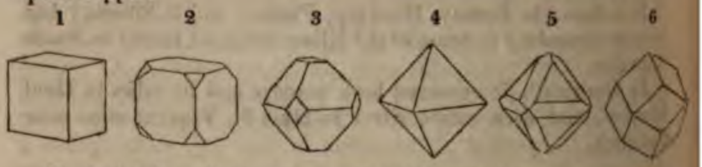
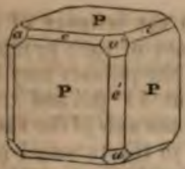


Fig. 1. A cube. Fig. 2, the same, of which the solid angles are replaced by triangular planes, which in fig. 3 are so greatly enlarged as to have become six-sided, reducing the planes of the cube to small quadrangles. The triangular planes of fig. 2 are complete in fig. 4; the regular octohedron. Fig. 5, an octohedron of which the edges are replaced, forming the passage of that solid into the rhombic dodecahedron, fig. 6, in which the planes replacing the edges of fig. 5, are complete. I possess upwards of 100 varieties in the form of the crystal, more than two-thirds of which are macles.



P on P or P	90°00′00″ H
P P or P on a′ or a ..	125.15.52 ..
—— —— — e′ or e ..	135. 0. 0 ..
a′ on a or a	109.28.16 ..
e′ on e or e	120. 0. 0 ..

It is found in the veins of primitive rocks and of the older secondary; it is occasionally accompanied by several of the ores of copper, and sometimes those of iron.

It occurs in veins traversing gneiss in Swabia and Saxony; in Salzburg in clay-slate; in the Hartz in greywacké; in the Bannat in a porphyritic sienite: also in Norway, &c. In several of the United States of America, in some of them in secondary rocks: in South America in Brazil and Chili, often in large masses on the surface.

In Cornwall, which is perhaps one of the greatest known depositaries of copper and its ores, native copper is found in very many of its mines. It occurs crystallized in the United Mines and Huel Music; in minute crystals aggregated in a leaf-like form in Huel Vor and Treskerby near Redruth; in cubes and octohedrons in Huel Gorland, with ruby copper and the arseniate of copper; in cubes in Huel Virgin near St. Day; capillary in Poldory in Gwennap, and Huel Prosper and Owan Vean in St. Hillary; these mines are in granite and clay-slate; it also occurs in serpentine near the Lizard. In Zell, one of the Shetland islands, it occurs in serpentine; and in Mainland in red sandstone. In one of the Faroe Isles beautifully crystallized in amygdaloidal trap.

VITREOUS COPPER. SULPHURET OF COPPER.

Kupfer glanz W. Cuivre sulfuré H. Bt. Cuivre vitreux Br. Vitreous Copper, Kirwan. Copper glance J. A. DI (424)

It is of a lead or iron-grey colour, often approaching to black CCCLIX
superficially, and is occasionally irridescent; internally it varies (42
from lead-grey to tin-white; it occurs crystallized in regular DXVIII
six-sided prisms, mostly modified on the terminal edges, some-
times on the lateral; and in acute and obtuse double six-sided (42
pyramids with triangular planes; it also occurs massive, and DIV (42
occasionally in pseudomorphous cubic crystals. The structure
is perfectly lamellar; all the solid angles of the prism may be CCCLX
removed by the knife, producing a double six-sided pyramid (42
with brilliant planes, the incidence of an upper on the adjacent
plane of the lower pyramid, being about 147° 30′ by the reflec-
tive goniometer; and that solid might be considered as the

form of the primary crystal, but, as in the instance of quartz, it may, by omitting the alternate planes of each pyramid, be converted into a rhomboid; and hence the primary may be considered as an acute rhomboid of about 71° 30′ and 108° 30′; it may also be cleaved at right angles to the axis of the rhomboid, or, which is the same thing, parallel to the terminal plane of the six-sided prism; the primary planes have never been observed on any one of its numerous crystals: the cross fracture of the crystallized is often conchoidal, with a vitreous lustre; the massive varies greatly in respect of hardness and colour; it is sometimes sectile and soft; the fracture is even, or flat conchoidal. Specific gravity 4.8—5.4. A specimen analysed by Chevenix yielded 81 copper, 19 sulphur; another from Rothenberg in six-sided prisms afforded Klaproth 76.50 copper, 22.0 sulphur, 0.50 iron, loss 1. Before the blow-pipe it fuses into a grey globule, which sometimes acts on the magnetic needle, sometimes does not.

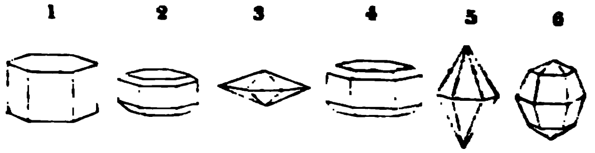
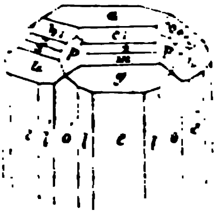


Fig. 1. The most simple of its forms; a six-sided prism. Fig. 2. the same, of which the terminal edges are replaced by planes tending to obtuse six-sided pyramids; which are complete in fig. 3, a flattish dodecahedron with triangular planes. Fig. 4. a six-sided prism of which the terminal edges are replaced by planes tending to acute six-sided pyramids; which are complete in fig. 5, forming an acute dodecahedron with triangular planes. Fig. 6 represents a crystal consisting of portions of the planes of the acute dodecahedron fig. 5, terminated by the obtuse dodecahedral planes of fig. 3.



a on b1 or c1	146°30′
— — b2 or c2	137.40
— — b3 or c3	135.30
— — b4 or g	116.40
— — e, e′ or e″	90.00
— — p or p′	130.00 c.g.
e on e′ or e″	120.00
e or e′ on o′	150.00
e on l or e′ on l′	168.34

It occurs in veins and beds in primitive and early secondary rocks, and is found with other ores of copper.

In Suabia, Bohemia, and Saxony, in veins traversing gneiss; in the Bannat in primitive limestone; and is found in many other European countries; abundantly in the Uralian mountains; in New Jersey, North America, in red sandstone.

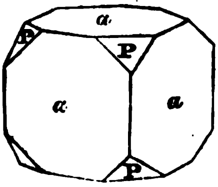
l it occurs abundantly in several of its mines, both
ıd massive, chiefly in Tin Croft, Cook's Kitchen,
Camborne Vean, which are on the same veins,
; also in Creaver, Oatfield, and Huel Abraham;
ıck mine, near the Land's End; the irridescent
These mines are chiefly in clay-slate. It has
t Middleton Tyas in Yorkshire. In Scotland
ı in transition rocks at Fassney Burn in East
ı in Ayrshire. In the Fair Isle, between the
ıetland Isles.
ses into Black Copper ore.

itreous Copper. Cuivre sulfuré hepatique H. It
colour of tempered steel, violet blue, greenish,
wish: it seems to arise from an intimate mixture
reous and yellow copper; both of which generally
stinctly in the specimen.
ırs in most of the mines of Cornwall in which
opper is found.

'KUPFERERZ. PURPLE COPPER.

I. Cuivre pyriteux hépatique H. Cuivre panachée ou
Cuivre pyriteux panachée Bt. Variegated Copper ore J.

ıoth massive and crystallized; the colour of the
to consist of an intimate mixture of copper red
own; in the crystallized, the latter colour pre-
irridescent tarnish, generally of blue, sometimes CCCCXC
general form of the crystals is that of the cube, (4
olid angles are replaced, and the faces are mostly
t also appears to occur in thin tables, which are DII
: these consist of a nucleus of vitreous copper, 4
ple copper; it is not perfectly lamellar, but mani-
ı mechanical division parallel to the planes of the
dron, in other directions the fracture is imperfectly
t is soft, easily frangible, and sectile in a slight
ific gravity 5.033. That of Norway consists of
, sulphur 19, iron 7.50, oxygen 4; Klaproth:
n from Ross Island, Lake of Killarney, yielded
s of my brother R. Phillips, copper 61.07, iron
ır 23.75, silex 0.5, loss 0.68; whence it may be
ınsisting of magnetic pyrites and variegated cop-
ı fusible, but not so easily as vitreous copper, into
ich acts powerfully on the magnetic needle.



P on P′ or P″	109°28′
P on *a*, *a*, or *a* ...	125.16
a on *a* or *a*	90.00

It is found both in primitive and early secondary rocks, and is associated with several of the other ores of copper, with iron pyrites, blende, &c.

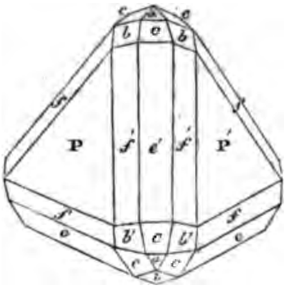
At Arendahl in Norway, it occurs in beds in gneiss with other ores of copper and with garnets; in the Hartz in veins traversing greywacké; in Saxony in gneiss: in Thuringia in bituminous marl-slate; and in some other European countries.

In Cornwall, it occurs in Cook's Kitchen, Tin Croft, and Dolcoath near Redruth, and in Camborne Vean mine on a peculiar kind of purple copper; also in Poldory, and Huel Jewell near St. Day: in these mines it is associated with vitreous copper both massive and crystallized, and yellow copper ore; in the latter with tennantite.

GREY COPPER. FAHLERZ.

Fahlerz W. Br. Cuivre gris H.

It is of a steel-grey or iron-black colour: it occurs crystallized in the form of a tetrahedron, which is considered to be the primary form of this mineral, in which however no regular structure is discernible; it also occurs massive and disseminated; the fracture is uneven or imperfectly conchoidal, with a shining or glistening metallic lustre; it is brittle. Specific gravity 4.5. It consists according to Chenevix of 52 of copper, 23 of iron, and 14 of sulphur.



P on P′	70.31.44.
P or P′ on *a*	109.28.16
——— on *b* or *b*′	144.44.10
——— on *e* or *e*′	125.15.54
——— on *f* or *f*′	160.31.44
a on *b*	144.44. 8
b on *b* or *b*	120.00.00
b or *b* on c	150.00.00
c or c on *c*	146.26.33
e on *f* or *e*′ on *f*′ or *f*′...	144.44. 8
f′ on *f*′	109.28.16
f on *f*′	146.26.33
f or *f*′ on *b*	150.00.00

The above figure and measurements are given on the authority of Haüy.

It occurs in veins and beds in primitive and secondary rocks, accompanied by iron and copper pyrites, and other ores of copper.

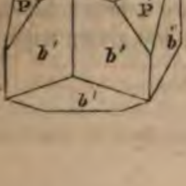
In Saxony it occurs in gneiss; in the Hartz in greywacké and clay-slate; in secondary limestone in the Tyrol; in Hungary, Transylvania, France, Spain, and Russia: in the Uralian mountains; and in Chili and Mexico in South America.

In Cornwall, it occurs very sparingly in the Crinnis mine; in Devonshire near Tavistock, and at Beeralstone. In Scotland, at Fassney Burn in East Lothian; at Airthrie in the Ochil hills; in Ayrshire; in the Mainland of Shetland.

Arsenical Grey Copper. Cuivre gris arsenifère H. This mineral like the foregoing occurs in tetrahedrons variously modified, also massive and disseminated. It is of a steel-grey colour, externally splendent, internally shining, with a metallic lustre; fracture approaching the conchoidal; CCCLVII (432 and it is brittle. Brongniart is of opinion that it is the Fahlerz of Klaproth. Analysis by Klaproth of a specimen from near Freyberg, copper 42.50, sulphur 10, arsenic 15.60, iron 27.50, silver 00.90, antimony 01.50, loss 02.00; but a specimen from Ayrshire in Scotland, analysed by Dr. Thomson, yielded 19.2 of copper, 14.1 of sulphur, 51.0 of iron, and 15.7 of arsenic.

It is found in various parts of Germany, in Cornwall, and in Scotland.

Antimonial Grey Copper. Schwarzerz W. Cuivre gris antimonié Bt. This mineral also occurs in modified tetrahedrons; it is of a dark lead-grey, approaching to iron-black, both externally and internally; the crystals do not appear to possess a regular structure, the fracture being uneven, and the surface glistening: it is not very brittle. Analysis of a crystallized variety from Kapnic, by Klaproth, copper 37.75, antimony 22.00, iron 03.25, sulphur 28.00, silver 00.25, zinc 00.50, loss 03.75. Another from Wenzel near Wolfach, yielded 13.45 per cent. of silver.



P on P′	70.31.44 H
P on b b′ or b″	144.44.00 ..
b on b b′ on b′ or b′ on b″	120.00.00 ..

It is found in Bohemia, Hungary, the Hartz, &c.; the preceding figure represents a crystal from Schwatz, Hartz.

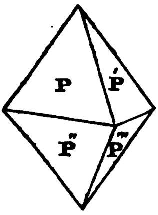
Platiniferous Grey Copper. This mineral is described as being of a grey colour, and generally agrees with fahlerz in its external characters. It consists, according to the analysis of Vauquelin, of copper, lead, antimony, iron, silver, platina, and sometimes sulphur; but the proportion of platina varies in different specimens from a minute quantity to 10 per cent. It is a rare mineral, having only been found at Guadalcanal in Estramadura in Spain, where it occurs with some varieties of the ores of silver and arsenic.

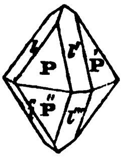
COPPER PYRITES. YELLOW COPPER-ORE.

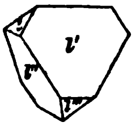
Kupferkies W. Cuivre pyriteux H. Bt. Pyrite Cuivreux Br.

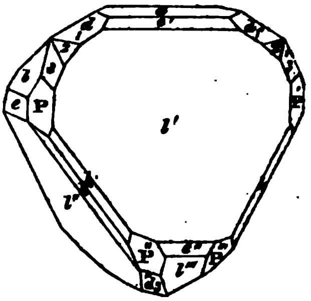
It is of various shades of yellow, but externally the crystals
are often irridescent; they are in the general form of the tetra-
XXXII hedron, having the solid angles always replaced: the tetrahedron
(433) is not the primary form of the crystals, of which the structure
is perfectly lamellar, affording brilliant surfaces parallel to
XXVII the planes of a somewhat acute octohedron with a square base;
(434) so that the tetrahedron, as is shewn in the following figures, is in
XXVIII fact only the remarkable consequence of an alternate enlargement
(435) of the planes *l*, modifying the edges of the primary octohedron:
the cross fracture is conchoidal and splendent; it is
brittle. It also occurs stalactitic, botryoidal, mamillated, and
XXXIII amorphous, the latter being often variegated: the fracture of
(436) the botryoidal and mamillated is even or uneven, the structure
being granular and often finely granular; these two varieties
are much harder than the crystallized and amorphous, and are
CXXXII very brittle. Copper pyrites yields to the knife, and may
(437) thereby be at once distinguished from iron pyrites which it
often greatly resembles; the colour of the former is generally
CI of the deepest yellow. Specific gravity 4.3. Analysis of the
(438) crystallized, of Cornwall, by my brother R. Phillips, copper
30.00, iron 32.20, sulphur 35.16, earthy matter 0.50, lead,
arsenic and loss 2.14. The analysis of the granular differs
from the foregoing in a very trifling degree in the proportions
of the same elements. It fuses on charcoal before the blow-pipe,
emits a sulphureous vapour, and melts into a brittle black globule,
which finally attracts the magnet; but giving with borax
metallic copper.

Primary.









P on P′	102°30′	d1 on d1′	133°50′
P on P″ or P′ on P‴	125.30	d1 on l	143.24
P on d1 or P′ on d1′	150.50	d3 on l	144.10
— — d3 or — — d3′	169.32	d3 on d3′	111.40
— — l, l′, or l″ or P′ on l′, l″, or l‴	141.15	k on k′	149. 2
e on l	126. 0	l on l′ or l″	110.00
d1 on d3, or d1′ on d3′	160.54	— — e or l‴ on d′	144.25
		l′ on l″	71.10

The primary crystal has not hitherto been found; the crystals represented by the other figures do occur; the largest of the four represents a crystal in my possession from Cornwall.

It is the most abundant of all the copper ores; it occurs both in primitive and secondary rocks; it is accompanied by or accompanies most of the other ores of copper, sometimes galena, oxide of tin, and several of the ores of iron.

It is found in most European countries in which copper occurs; also in Siberia, Japan, North and South America, and in Africa.

In England, it is the most abundant ore of the Cornish mines, and occurs in veins both in granite and clay-slate. The finest crystallized specimens occurred in Tin Croft, North Downs, Huel Towan, and Trelethra mines. The mamillated in Tin Croft, Dolcoath, and Huel Fanny; it is sometimes intermixed with buntkupfererz, and associated with vitreous copper; it occurs massive, intimately mingled with tin, in Trevascus; in masses two or three inches long, apparently rounded by attrition, loose in the vein of Ale and Cakes mine, at a great depth from the surface. In Derbyshire in small quantity in two or three of the lead mines of that county. In Staffordshire in the Ecton mine, in transition limestone; sparingly in the cavities of argillaceous iron-stone, lying between the beds of coal at Wednesbury in Staffordshire. In small quantity in a lead vein at Cross Gill on Aldstone moor, in Cumberland. In Anglesey in a bed of great thickness, with native copper, &c. In Scotland, in veins traversing quartz in the Clifton mine near Tyndrum in Perthshire; in Mainland, one of the Shetland isles. In Ireland in the mines of Cronebane and Ballymurtagh in Wicklow.

It often passes into black copper ore.

Arsenical Copper Pyrites, White Copper. Weiss cupfererz W. Cuivre blanche Br. It is of a colour between silver-white and pale brass-yellow, with a glistening metallic lustre, but soon tarnishes by exposure. It occurs massive and disseminated; the fracture is fine grained uneven; it yields easily to the knife, and is brittle. Specific gravity 4.5. It consists of 40 per cent. of copper, the remainder consisting of iron, arsenic, and sulphur. Henckel. Before the blowpipe it yields a white arsenical vapour, and melts into a greyish-black slag.

It is far less abundant than copper pyrites, but is commonly found with it and other ores of copper.

It has been found in Huel Gorland in Cornwall.

In the year ending 30th June, 1817, 73,727 tons of copper ore (principally of copper pyrites) which sold for £410,936, and yielded 6,425 tons of pure copper, were raised from the mines of Cornwall only; being more than three-fourths of the quantity raised from the British mines.

SELENIURET OF COPPER.

This mineral is described by Berzelius as occurring massive and dendritic; as greatly resembling native silver in aspect; and as being malleable, and susceptible of polish.

It occurs in a copper mine at Scrickerum in Smoland, Sweden, associated with calcareous spar, or disseminated in serpentine?

TENNANTITE.[*]

This mineral varies internally from lead-grey to blackish-grey. It rarely occurs massive, but is commonly crystallized in the form of the rhombic dodecahedron, either perfect or variously modified; also, in the form of the cube and regular octohedron, of which the edges and angles are replaced. Externally the crystals are often very splendent, and nearly of a tin white colour; sometimes lead-grey with but little lustre; occasionally approaching to iron-black and dull; the fracture is imperfectly lamellar and uneven, with the appearance (by reflection from surfaces produced by mechanical division) of natural joints parallel to the planes of the regular octohedron, which may be considered as the primary form of the crystals, as also is indicated by occasional striæ on the planes of the dodecahedral crystals parallel with their longer diagonal. It is harder than vitreous copper and grey-copper, which it readily scratches, and is brittle. Its powder is reddish-grey. Specific gravity 4.375. A specimen analysed by my brother R. Phillips, consisted of copper 45.32, arsenic 11.84, iron 9.26, sulphur 28.74, silex 5. Before the blow-pipe on charcoal, it first burns with a blue flame and slight decrepitation, to which succeed copious arsenical vapours; leaving a greyish-black scoria which affects the magnetic needle.

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[*] In honour of the late excellent chemist, Tennant.

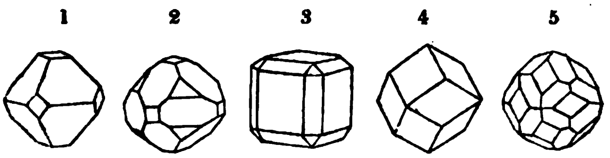
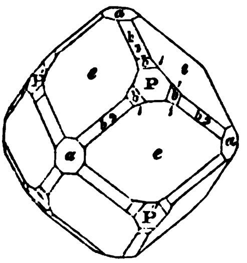


Fig. 1. The regular octohedron, of which the solid angles are replaced. Fig. 2. In this the edges are also replaced; the same planes appear on fig. 3. Fig. 4. The rhombic dodecahedron. Fig. 5. The same, of which the edges are replaced.



P on P′ or P″	109°30′
—— b1	168.56
—— b2	161.30
a on a	90.00
—— b2	144.50
a on e or e..........	135. 4
e on e or e..........	120.00

It has been found in several of the copper veins of Cornwall, passing through granite and clay-slate; and usually occurs investing other ores of copper, chiefly the irridescent and botryoidal varieties of copper pyrites, and is sometimes accompanied by black copper, vitreous copper, and buntkupfererz.

It has occurred in Dolcoath, Cook's Kitchen, and Tin Croft copper mines near Redruth, and in Huel Virgin, Huel Jewell, and Huel Unity, near St. Day in Cornwall.

RED OXIDE OF COPPER. OXYDULATED COPPER.

Rothkupfererz W. Cuivre oxydulé H. Bt. Cuivre oxidé rouge Br.

The colour of this mineral is red of various shades, by transmitted light sometimes crimson red. It occurs crystallized in (439) the form of the octohedron and its varieties, which are very numerous; the crystals are externally splendent, occasionally irri- (440) descent, but are sometimes superficially of a lead-grey colour, with a metallic lustre, sometimes nearly black and dull: the structure is lamellar; it is mechanically divisible, but the joints (441 are not easily attained, parallel with the faces of the regular octohedron, which therefore is esteemed to be the form of the primary crystal; the cross fracture is sometimes uneven, more often conchoidal with a splendent and somewhat adamantine lustre; it is transparent or translucent, yields easily to the knife, and is brittle. Specific gravity 4.9—5.6. That of Cornwall consists, according to Chenevix, of 88.5 copper, and 11.5 of oxygen: that of Siberia, according to Klaproth, of 91 copper, and 9 oxygen. Before the blow-pipe, it is easily reducible on charcoal to the metallic state.

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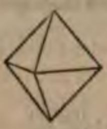

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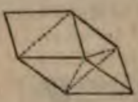

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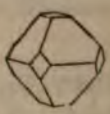

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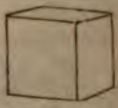

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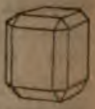

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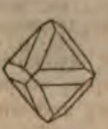

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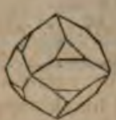

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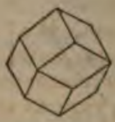

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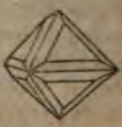

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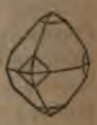
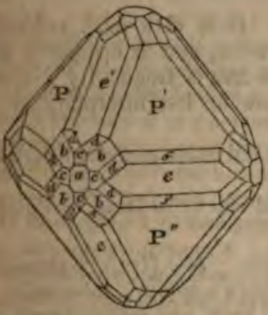


Fig. 1. The primary; the regular octohedron. Fig. 2, An acute rhomboid, arising as will be perceived by the dotted lines, from an increase of crystalline laminæ on two opposite and parallel planes of the octohedron, the laminæ progressively diminishing to a point; it will also be perceived that the acute rhomboid consists of one octohedron (but in a somewhat different point of view to fig. 1) and two tetrahedrons. Fig. 3, An octohedron of which the solid angles are replaced by quadrangular planes; these planes meet, and are complete in fig. 4, forming the cube. Fig. 5, the cube, of which the edges and solid angles are replaced. Fig. 6, An

octohedron of which the edges are replaced by six-sided planes; which, in fig. 7, are increased: and, in fig. 8, are complete, forming the rhombic dodecahedron. Fig. 9, An octohedron of which each edge is replaced, or bevelled, by two planes. Fig. 10, An octohedron, of which each solid angle is replaced by four triangular planes, forming an obtuse pyramid on each. There are about 100 varieties in the form of the crystal, arising chiefly from various combinations of the planes exhibited in the above figures.



P on P′ or P″	109°.30′
P P′ or P″ on *a*	125 .10
———————— *b*	160 .42
a on *b*	144 .38
e on *e* or *e*′..............	120 .00

It is found both in the primitive and transition rocks, associated with native copper and many of its ores.

It occurs at Chessy in France in isolated crystals, generally coated by green carbonate; in the Hartz; in Saxony, Bavaria, Hungary, the Bannat, in Norway and Sweden and in the Uralian mountains; also in Chili and Peru, and in several of the United States of North America in small quantity.

It has been found finely crystallized in several of the copper mines of Cornwall; as in Polgine and Huel Prosper; in Tin Croft near Redruth; in West Huel Virgin, Carharack, Huel Gorland, Huel Muttrell, and Huel Unity in Gwennap; in Huel Speed and Carvath near St. Ives; in Huel Music near St. Agnes; and in Gunnis-lake on the banks of the Tamar. It occurred most abundantly in Huel Gorland, Huel Muttrell, and Huel Unity, which are on the same veins, traversing both granite and schist; in these mines it was accompanied by native copper, copper pyrites, arsenical pyrites, vitreous and black copper; and with arseniated iron, arseniated copper, and the martial arseniate of copper.

Capillary Red Oxide of Copper. This differs from the preceding only in consisting of very minute transparent or translucent crystals which are extremely slender; they are chiefly quadrangular prisms (elongated cubes), or quadrangular prisms terminated by diedral summits (elongated octo- CXLVI (44 hedrons); they cross each other at right angles, or are solitary, or variously aggregated, sometimes are so fine as to appear fibrous or flocculent.

It has been found in most of the mines of Cornwall in which the crystallized occurs; occasionally in the cavities of an ochreous siliceous stone (the gossan of the miner), and in decomposed granite.

Massive Red Oxide of Copper. It is of a dark red colour, frequently with a metallic lustre, and is opaque or translucent on the edges; the fracture is frequently granular; and it is almost always more or less intermingled with native copper.

It occurs with crystallized red oxide and green carbonate of copper.

In Cornwall, it was found chiefly in Huel Gorland and the Muttrell mine.

Ferruginous Red Oxide of Copper. Tile Ore. Externally it is of a brick red or reddish brown colour; internally it is sometimes of a dark metallic grey, and is then nearly compact and hard; more commonly, the fracture is earthy;
CCLXXV it yields to the knife, sometimes to the nail, and is opaque.
(443) Before the blow-pipe it blackens but does not fuse. It has not been analysed, but is supposed to consist of red oxide of copper and iron.

It is found, but not plentifully, with red oxide of copper in some of the mines of Cornwall; it sometimes invests the surfaces of the crystals. It has also been found in Llanymynech hill in Shropshire.

BLACK COPPER.

Kupferschwarz W. Copper black J.

It is bluish or brownish black, or black: it rarely occurs massive, mostly disseminated in, or investing other ores of copper; it is commonly very friable, and more or less soils
CCXCV the fingers, and is heavy. Before the blow-pipe it is infusible,
(444) and does not give out a sulphureous odour; with borax it yields a greenish slag.

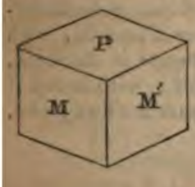
It occurs on the surface of and associated with the botryoidal varieties of copper pyrites, with crystallized and massive red oxide of copper and vitreous copper, and may not improperly be considered as resulting from the decomposition of those ores, which are frequently found passing into Black Copper.

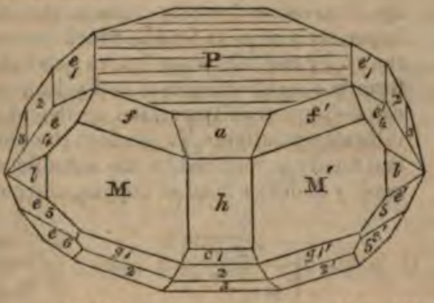
It has been found in most of the mines of Cornwall, in which they occur.

BLUE CARBONATE OF COPPER.

Kupferlazur W. Cuivre carbonaté bleu H. Azur de Cuivre Br. Azure Copper Ore J. Blue Copper. E. CIV 132

It is of a smalt-blue colour, sometimes with a tinge of black. It occurs crystallized in a great variety of forms; the structure is lamellar in several directions, of which the cleavage parallel to the plane P of the following figures is most difficult of attainment; it cleaves easily parallel to the planes MM, and both diagonals of an oblique rhombic prism, which may be considered as the primary form of its crystals, of which the plane P is usually striated in the direction indicated by the lines on the largest of the following figures; it also cleaves easily parallel to the planes *e* 3 *e* 3 of that figure; the cross fracture is often conchoidal with a vitreous lustre; it varies from nearly transparent to opaque, the most complex crystals possessing the greatest degree of translucency; it yields easily to the knife. Specific gravity 3.2—3.6. By a late analysis of my brother, R. Phillips, it consists of peroxide of copper 69.08, carbonic acid 25.46, water 5.46. Before the blow-pipe it blackens but does not melt; with borax on choarcoal it effervesces, gives a metallic globule, and colours the flux green. It is soluble with effervescence in nitric acid. CCIII 144





P on M or M′	91°30′	M on *g*1 or M′ on *g*′1 ...	142°56′
M on M′	98.50	— — *g*2 or — — *g*′2 ..	131. 4
P on *a*	135.15	— — *h* or — — *h*	139.15
— — *e*1 or *e*′1	149.20	— — *l* or — — *l*	179.26
— — *e*2 or *e*′2	138.12	*a* on *f* or *f*′	139.30
— — *e*3 or *e*′3	119.30	— — *h*	136.45
— — *e*4 or *e*′4	115.30	*e*1 on *e*2	169. 2
— — *f* or *f*′	112.15	— — *e*4	141. 6
— — *h*	92.15	— — *f*	129. 0
M or M′ on *a*	123.40	*e*3 on *e*3′ over P	120.30
M on *e*1 or M′ on *e*′1 ...	111. 5	— — *e*5	157. 5
— — *e*2 or — — *e*′2 ...	116.55	*g*1 on *g*2	168.15
— — *e*4 or — — *e*′4 ...	149. 5	— — *e*6	164.24
— — *e*5 or — — *e*′5 ...	156. 5	*h* on *c*1	154. 4
— — *e*6 or — — *e*′6 ...	138.30	— — *c*2	134.55
— — *f* or — — *f*′	159.50	— — *c*3	115. 0

It occurs in the veins of primitive and secondary mountain chiefly with the green carbonate and red oxide of copper, i Chili, Bohemia, the Hartz, Saxony, the Uralian mountains, an in Thuringia: at Chessy in France, &c.

In Cornwall, sparingly in Huel Muttrell and Huel Gorland Huel Unity, Huel Virgin and Carharack. In the Buckingha mine near Bridgewater, Somersetshire. At Alderley Edge i Cheshire, in sandstone with yellow copper and barytes. I Durham, at Wassinghope lead mine, near Stanhope, in smal nodules imbedded in sulphate of barytes.

In Scotland at Wanlock head, and the lead hills in Lanarkshire.

IX Fibrous Blue Velvet Copper.

·33

GREEN CARBONATE OF COPPER.

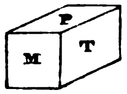
Of green carbonated copper there are three varieties.

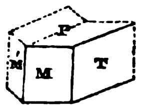
*Fibrous Green Carbonated Copper. Fibrous Malachite.** Malachit W. Cuivre carbonaté vert H. It is of various shades of green, and occurs in slender fibres, which sometimes are fasciculated, sometimes stellated; externally they are shining, and the lustre is often silky; it is soft and brittle. In the cavities, however, are sometimes to be observed extremely minute and transparent crystals in perfectly regular forms, which in reality are macles, as shewn by the following figures; and of which the primary form is a right oblique-angled prism, yielding to mechanical division readily parallel to the planes P and M, with difficulty parallel to T. Before the blow-pipe it blackens, and finally is reduced to the metallic state; with borax it readily affords a bead of copper, and colours the flux green.

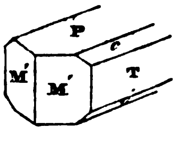
V (446)

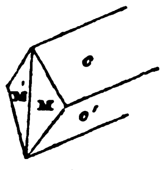
IV/447

/11 (448)









P on M, M′, or T ..	90°00′	M on c or c′	112°33′
M′ on M	123.35	c on c′	107.16

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* Malachite, from the Greek; Marsh Mallow; the colour of both be green.

It occurs in veins in primitive and secondary mountains with other ores of copper, as the blue carbonate, copper pyrites, vitreous copper, ruby copper, &c.

It is found in Silesia, the Hartz, Hesse, Lusace, Norway, Sweden, Russia, the Uralian mountains, and in some of the United States of America.

In Cornwall it has been found with blue carbonate in Carharack mine, also in Huel Husband and West Huel Virgin; in Huel Music in St. Agness, in Hewas mine near St. Austle, and in Gunnis-lake mine on the banks of the Tamar; on brown iron-stone in the Buckingham mine near Bridgewater, Somersetshire. In the north of England in small quantities in the Dufton lead mines, and in the Dale-head mine, Cumberland. In Mainland, one of the Shetland isles, in a red sandstone with other ores of copper.

CCLXXI
(44

CCLXX
(45

In Wales, at Llandidno in Caernarvonshire.

CCCII
(45

Massive Green Carbonate of Copper. Massive Malachite. Dichter Malachit W. Cuivre carbonaté vert concretionné H. It occurs botryoidal, reniform, stalactitic, and cellular; its colour is nearly the same as the fibrous; the structure is concentric lamellar in one direction, fibrous in the other; the fracture is conchoidal or uneven; the lustre is glistening or silky. Specific gravity 3.5. According to the analysis of my brother R. Phillips, it consists of peroxide of copper 72.2, carbonic acid 18.5, water 9.3. In the green carbonate, therefore, there appears to be more copper and more water, but much less acid than in the blue carbonate.

It is found, generally speaking, under the same circumstances and in the same places as the blue carbonate and the fibrous malachite.

In Cornwall it occurred in the same mines as the latter, but carbonated copper is not of common occurrence in that county; also in the Buckingham mine, near Bridgewater in Somersetshire.

Epigène Green Copper. Cuivre carbonaté vert epigène H? It is found in the form of the octohedron, sometimes with the edges replaced, and in that of the rhombic dodecahedron. It is believed to be a red oxide of copper altered by the absorption of oxygen and of carbonic acid: the red oxide is occasionally found in the centre of the crystal. It occurs at Chessy in France.

CHRYSOCOLLA.

Kupfergrün W. Cuivre carbonaté terreux H. Chrysocolle Br. Copper Green J.

It is of various shades of green, yellowish-green, also greenish-brown, reddish-brown, and blackish-brown (*Pitch Copper*). It occurs botryoidal, stalactitic, reniform, massive, and investing other ores of copper; the fracture varies from earthy to conchoidal; it is translucent or opaque; it is shining or dull; in hardness it varies from the almost friable to that of common quartz. A variety from Siberia, yielded 40 of copper, 10 of oxygen, 7 of carbonic acid, 26 of silex, and 17 of water. Before the blow-pipe on charcoal it blackens in the exterior flame and reddens in the interior, but does not fuse; with borax fuses into a glass, presenting the effects of copper.

This substance often differs greatly in appearance; in the same specimen it sometimes bears at one end the character of an earthy decomposed felspar, which passes by insensible degrees towards the other into brittle translucent green chrysocolla, or brownish or blackish pitch copper, which in other specimens are found intermixed; again, this substance passes from the latter into a substance greatly resembling hornstone both in hardness and fracture.

It is found in veins in primitive and secondary mountains, with other ores of copper, as the red oxide, copper pyrites, carbonated copper, &c.

It is found at Zinwald in Bohemia; in the Tyrol in limestone; in the Bannat, Hungary, Siberia, and Mexico.

In Cornwall, all the varieties occurred in Huel Muttrell, Huel Gorland, and Huel Unity, near St. Day, with the ruby copper and arseniate of copper; the variety called pitch copper in Carharack near St. Day, and in Prince George in Gwinear. In Cumberland, in the vale of Newlands near Keswick.

DIOPTASE.* EMERALD COPPER.

XXIV Kupferschmaragd W. Cuivre dioptase H. Bt. Br.

134 In colour it approaches emerald-green; it occurs in crystals, having the general form of elongated rhombic dodecahedrons; the structure is lamellar; it yields to mechanical division parallel to the planes of its primary crystal, an obtuse rhomboid of 126° 17′ and 53° 43′ by the reflective goniometer from planes pro-

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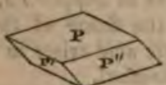
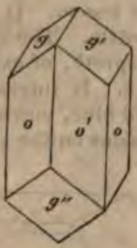
* From the Greek: in allusion to the possibility of seeing (by transmitted light) the natural joints.

duced by cleavage; the cross fracture is flat conchoidal; it is translucent, with a shining lustre, scratches glass feebly, and is brittle. Specific gravity 3.3. It consists of 28.57 oxide of copper, 42.85 of carbonate of lime, 28.57 of silex, by the analysis of four grains by Vauquelin; but according to a later analysis by Lowitz, it consists of oxide of copper 55, silex 33, water 12. Before the blow-pipe the results are the same as those of chrysocolla.

Primary.





P on P′ or P″ primary	53°43′
g on g′	95.33
o′ on o or o	120. 4
g on o or g′ on o′	133. 0

It has been found in Kirguise in Siberia, associated with malachite copper. Minute crystals accompany the electric calamine of Rysbania in the Bannat.

SULPHATE OF COPPER. BLUE VITRIOL.

The colour is a fine blue, which sometimes passes into bluish-green; it occurs massive, stalactitic, and pulverulent; to the taste it is nauseous, bitter, and metallic. When artificially prepared, it crystallizes, but is rarely so found in the natural state. It consists according to Berzelius of oxide of copper 32.13, sulphuric acid 31.57, water 36.30. When a portion of it is dissolved in water, and spread on the surface of iron, the latter is immediately covered by a film of copper.

CCCLI
(4

It is found in considerable quantity in some of the copper mines of the Continent of Europe. In Cornwall, lately in the Consolidated mines near St. Day, and sparingly in Huel Unity. In Anglesey, it occurred in the Parys mine, with copper pyrites; and in the copper mines of Wicklow in Ireland.

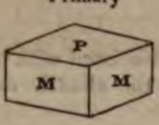
MURIATE OF COPPER.

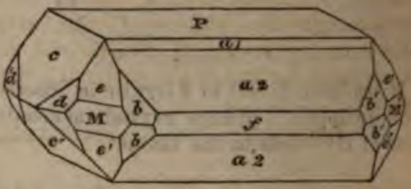
Salzkupfererz W. Cuivre muriaté H. Bt.

It is of various shades of green; by transmitted light, sometimes of an emerald green. It occurs in minute crystals of which the primary form is a right rhombic prism, of about 100°. &

80°. by the common goniometer, on the planes M M′ produced by cleavage, which however have never been observed on the crystals, but are represented in the following figure to shew their position. Among the minute crystals of the Atacamite are to be observed some in which the planes *a* 2, *a* 2′ & c, c′, of the following figure prevail to the exclusion of the rest, converting them to the form of an octohedron with a rectangular base. The planes produced by cleavage parallel to the plane P, are very brilliant and easy of attainment: those parallel to M & M′, are less so. It is translucent or nearly transparent, soft, and brittle. The specific gravity is 4.4. It consists, according to Klaproth, of oxide of copper 73, muriatic acid 10.1, water 16.9. It tinges the flame of the blowpipe of a bright green and blue, muriatic acid arises in vapours, and a bead of copper remains on the charcoal.

Primary





M on M	100°.00′?	*a* 2 on *c*	110°.30′
P on *a* 1	142 .40	—— *e*	143 .25
—— *a* 2	123 .25	c on c′	107 .10
—— c	127 .12	—— *d*	159 .00
—— *e*	116 .20	—— *e*	137 .40
a 2 on *a*′ 2	112 .45	*e* on *e*	127 .07

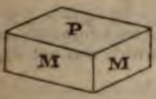
It is found at Remolinos in Chili, on brown iron-stone; sometimes with ruby copper and carbonate of copper; in Peru with some of the ores of silver. The green sand was found in the river Lipas, in the desert of Atacama (whence this variety has sometimes been termed *Atacamite*), separating Chili from Peru. Muriate of copper has also been found investing some of the lavas of Vesuvius.

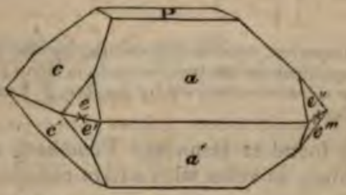
PHOSPHATE OF COPPER.

Phosphorkupfererz W. Cuivre phosphaté H. Br. Bt.

It occurs crystallized, and in radiating masses: externally the crystals are greenish or blackish green, approaching nearly to black, and are considerably splendent, but their surfaces are ıeven, and not well adapted to the use of the reflective gonio-eter; they vary from translucent to opaque: by transmitted ;ht their fragments are olive green, occasionally with a tinge yellow, and they afford a blackish olive green powder: DXXXI (45 hen radiating the colour is bluish green and black intermixed, e exterior being often nearly black: the minute crystals of ornwall are yellowish-green and transparent. The crystals e often prismatic, but occasionally the prism is so short as reduce them to the general figure of an octohedron. They ssess a distinct cleavage parallel to the plane P of the follow-g figure; less perfect cleavages may also be attained parallel the edges *x x*, thus reducing the crystals to the form of a ght rhombic prism of about 110°. & 70°. by the common go-ometer, which may be considered as the form of the primary ystal. Specific gravity 3.5. Analysis of a specimen from heinbreitbach, 68.13 oxide of copper; 30.95 phosphoric acid, laproth. On the first impression of heat it fuses into a ownish globule, which by further action of the blow-pipe, tends on the surface of the charcoal, and acquires a reddish ey metallic lustre; in the centre is a small globule of metallic pper.

Primary.





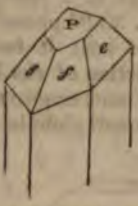
M on M or *x* on *x*	110°.00? *c. g.*	*c* on *c*	121 .15
P on *c*	126 .10	—— *e*	149 .10
a on *a'*	95 .15		

It is found near Rheinbreitbach; at Liebethen near Neushole Hungary. In Cornwall, both crystallised and fibrous in unnis Lake mine on the banks of the Tamar.

HYDROUS PHOSPHATE OF COPPER.

Rev. F. Lunn.

It occurs both crystallized and massive. The colour of the assive approaches to emerald green, striated with black or ackish green, and it appears to consist of minute crystals ten diverging or radiating. The more determinate crystals e generally dull and of a blackish green colour externally, ccasionally black and splendent, by transmitted light they are emerald green; in powder, verdigris green. The crystals occur aggregated, part only being visible; the form has not therefore been precisely determined; enough however is visible to shew that it is essentially different to that of the Anhydrous Phosphate, and that the primary crystal is probably an oblique rhombic prism. Specific gravity 4.2 of the radiating variety from near Bonn; which by the analysis of the Rev. F. Lunn, consists of peroxide of copper 62.487, phosphoric acid 21.687, water 15.454. By exposure to a red heat in a close crucible, it becomes of a dark olive green colour, and the powder increases considerably in bulk. Before the blow-pipe on charcoal it readily fuses into a reddish black slag, and by the addition of carbonate of soda it is reduced to a bead of pure copper.



P on *e* .... 115°.38′
—— *f* .... 123 .48
f on *e* .... 135 .45

The imperfect crystals represented by the foregoing figure, were taken from a specimen in my possession from Bonn; it is therefore only assumed to be the substance analysed by the Rev. F. Lunn, which was not regularly crystallised.

It is found at Bonn and Virneberg near Rheinbreitbach on the Rhine, in veins with native copper, &c.

ARSENIATE OF COPPER.

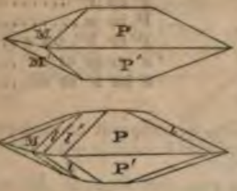
There are several varieties of arseniate of copper, which differ somewhat in their chemical characters, but which are very readily distinguishable by their external forms.

1. OCTOHEDRAL ARSENIATE.

Octohedral arseniate, Bournon. Linsenerz W. Cuivre arseniaté primitif H. Lenticular Copper-ore J.

XVIII
(454) It is found of a bluish-white, sky-blue, and smalt-blue, also
XIV (455) greenish-white and deep grass-green: it is translucent, or translucent only on the edges; it yields to mechanical division,
(X h difficulty, parallel to all the planes of an obtuse

octohedron, of which the common base of the two pyramids is rectangular: the cross fracture is uneven with a vitreous lustre; it is scratched by fluor. Its specific gravity is 2.88. It consists of 49 oxide of copper, 14 of arsenic acid, and 35 of water. Chenevix. Before the blow-pipe, it is converted to a black friable scoria, and by subsequent fusion with borax affords a bead of copper. XXX (4



P on P′	60°40′
M on M′	72.22
P on l′	179.22
M on P or M′ on P	.. 133.30
l on l..........	178.10

It has been found only in the veins passing through the adjoining mines, Huel Muttrell, Huel Gorland, and Huel Unity in Cornwall, associated with the following varieties; also with red oxide of copper, copper pyrites, arseniate of iron, and the martial arseniate of copper.

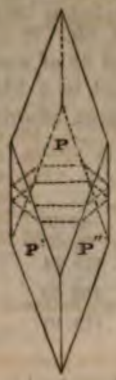
2. RHOMBOIDAL ARSENIATE.

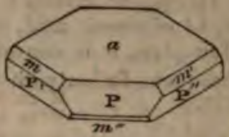
Hexahedral arseniate, Bournon. Cuivre arseniaté lamelliforme H.
Copper mica J.

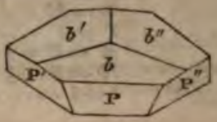
It is commonly of a pure green colour, rarely bluish-green or greenish-white; it occurs in six-sided tabular crystals, of which the lateral planes are trapeziums, inclining alternately in contrary directions, being sections of an acute rhomboid of about 110° 30′ and 69° 30′ by measurements taken by the reflective goniometer from the natural planes, and it yields to cleavage parallel with all the planes of the rhomboid, but with perfect ease and brilliancy only in a direction at right angles to its axis, i. e. parallel only to the tabular planes of the six-sided crystals: the crystals are sometimes arranged in rose-like forms: it is ransparent or translucent, and is scratched by calcareous spar. pecific gravity 2.5. It consists of 58 oxide of copper, 21 of enic acid, and 21 of water. Chenevix. Before the blow- it decrepitates, and passes first to the state of a black scoria, after which it melts into a black globule of a vitreous appearance; by the addition of borax, it affords of copper. XXXVI (45

ted lines in the first of the following figures, shews the portion of r crystal in the primary rhomboid.

Primary.







P on P' or P'' ...	110°30'
P' on P''	69.12
P on *a*	108.40
P' or P'' on *a*	128.18
a on *m* or *m'*	124.42
b on *b'* or *b''*	179.35

It was found accompanying the preceding variety in the same mines; also in Huel Tamar and in Gunnis Lake mines on the banks of the Tamar.

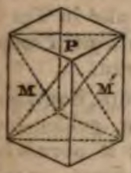
3. OBLIQUE PRISMATIC ARSENIATE.

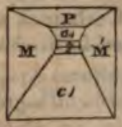
Trihedral arseniate, Bournon. Cuivré arseniaté prismatique triangulaire H. Trihedral Oliven-ore. J.

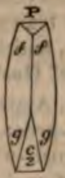
This variety is externally of a bluish black passing into a deep black, with a shining lustre: it occurs, though rarely, in ex-
CIII (460) tremely minute crystals, which may readily be mistaken for acute rhomboids, of which the acute terminations are sometimes
CIV (461) replaced by triangular planes; these crystals however are in fact oblique rhombic prisms, of which the lateral planes meet alternately at angles of about 56° and 124°, and of which the oblique terminal plane declines from one acute angle to the
CCLXIV (462) other: the crystals are frequently fasciculated in a somewhat radiating position, so that only the terminal planes of the following figures are distinctly visible, sometimes however these planes are irregularly quadrilateral, owing to the presence of the modifying planes. It also occurs in curved lamellar concretions, which are nearly black externally. The minute crystals are often transparent and of a very beautiful blue or greenish blue colour, by transmitted light; the larger crystals are sometimes black and opaque, but on being scratched or scraped by the knife, are found to be internally of a blue colour. It is somewhat harder than calcareous spar. Specific gravity 4.2. It consists of 54 oxide of copper, 30 of arsenic

acid, and 16 of water. Chenevix. Before the blow-pipe it flows like water, and in cooling crystallizes in small rhombic plates of a brown colour.

Primary.







M on M'	56° 0'
P on M or M'	95. 0
— — *a* 1	125. 0
— — c 1	80.30
— — c 2	99.30
f on *f*	62.30

The dotted lines on the primary shew, that from the replacement of its acute angles, arise the planes *c* 1 of the second figure.

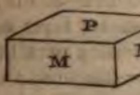
It was found, though not very abundantly, with the preceding and succeeding varieties in the veins of Huel Muttrell, Huel Gorland, and Huel Unity in Cornwall.

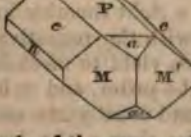
4. RIGHT PRISMATIC ARSENIATE.

Prismatic arseniate, Bournon. Cuivre arseniaté; octaèdre aigu H. Prismatic Oliven-ore J.

The colour of this variety is brownish or yellowish-green of various degrees of intensity; it occurs in prismatic crystals which are mechanically divisible parallel to the planes of a right rhombic prism of about 110° 50' and 69° 10' by measurements taken with the reflective goniometer on the planes parallel with those which are producible by cleavage (M M'), which are not brilliant except in the direction of the plane P: sometimes however the planes *e e* prevail to the exclusion of P, and the prism is then occasionally so short as to give the crystal the general form of an octohedron with a rectangular base; the plane *a* is extremely rare; the crystals are usually attached to the matrix at the planes M M' or their opposite planes; it also occurs capillary: the lustre is between vitreous and resinous: it is harder than fluor. Specific gravity 4.2. It consists of 60 oxide of copper, 39.7 arsenic acid. Chenevix. Before the blow-pipe it first boils, and then gives a hard reddish-brown scoria.

Primary.





M on M' ...	110°50'
P on M or M	90.00
M or M on *a*	132. 7
c on c over P	92.30

Capillary. This variety is of the same colours as the preceding, and occurs in minute crystals, occasionally exhibiting the

XCIII
(463)

planes *c*, *c*, of the preceding figure; sometimes they are indeterminate, the capillary prisms being distinct for a part of their length, and terminated by extremely minute fibres of a greenish white colour, and silky lustre, thus passing into the succeeding variety. It occurred in Huel Gorland, and Huel Unity near St. Day; also in Tin Croft mine near Redruth, and in Carharack and Huel Prosper in St. Hillary and Huel Husband in St. Mewan.

Amianthiform Arseniate. Amianthiform Arseniate, Bournon. It is of bluish or grass-green, brownish-green, golden-brown,
✓ (464) straw-yellow, greenish-white, or white; it occurs in extremely fine parallel or diverging flexible fibres, or minute lamellæ, often with a very silky lustre. It consists of 50
✓1 (465) oxide of copper, 29 of arsenic acid, and 21 of water; sometimes however the diverging fibres separate, and become dull, owing as it is supposed to the evaporation of the water.

It occurred with the preceding varieties in the same mines; also extremely fine in Tin Croft near Redruth.

Hæmatitic Arseniate. Wood Copper. Hæmatitic arseniate, Bournon. Cuivre arseniaté mamelonné fibreux H. Fibrous Oliven-ore J. It occurs of various shades of brown, green, and yellow, often whitish or yellowish, and is found investing some of the preceding varieties, also mamillated; the structure is finely and divergingly fibrous, generally with a silky lustre; superficially it is occasionally coated by the terminations of the small fibrous crystals of which it is composed. It sometimes possesses a considerable degree of hardness, sometimes it adheres to the fingers. It consists of 50 oxide of copper, 29 arsenic acid, and 21 of water. Chenevix. Before the blow-pipe it gives a hard black cellular scoria.

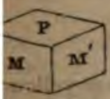
MARTIAL ARSENIATE OF COPPER.

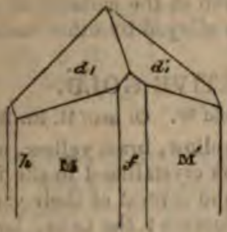
Cuprous arseniate of Iron, Bournon. Cuivré arseniaté ferrifère H.
Martial arseniate of Copper J. A.

It is either nearly colourless, or of a pale blue colour, sometimes with a tinge of green, and occurs in transparent or trans-
(466) lucent prismatic crystals terminated by four-sided pyramids; the primary form is a right rhombic prism of 120° & 60°, by measurements taken with the reflective goniometer from natural planes; the crystals yield to mechanical division parallel to the planes M, M, of the prism, and to its lesser diagonal; they are not often single, and usually are small, often minute, and grouped in a globular form; the lustre is vitreous; it is

rder than calcareous spar. It consists of 22.5 oxide of pper, 33.5 arsenic acid, 27.5 oxide of iron, 12 water, and 3 ex. Chenevix.

Primary.





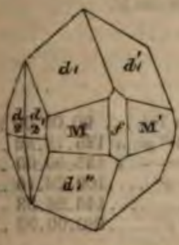
M on M......120°.00'
M on dl, or } M' on dl'. } 141 .26
dl on dl' ... 103 .00

t occurred in the Muttrell mine, and in Huel Unity, and el Gorland, in Cornwall, associated with, or deposited upon ic arseniated iron: also in Tin Croft and Carharack mines. t was found also at St. Leonhard in France with cubic eniate of iron.

1. SKORODITE.*

Breithaupt.

This mineral perfectly resembles the martial arseniate of per, in its external characters. It occurs both crystallized massive; the crystals often radiate from a common centre, possess considerable external lustre, are of various colours, en, bluish-green, brown, and nearly black, and sometimes y are nearly colourless and transparent; the coloured crys- are often nearly opaque. Its specific gravity is 3.2. Before blow-pipe on charcoal, Berzelius found it give off abundant es of arsenic, leaving a grey scoria attractable by the net. It has not been analysed.



M on M............120°.10'
M on dl, or } M' on dl'.. } ......141 . 5
M or M on f........149 .55
dl on dl' ....103 . 5

t is found at Kraul or Graul near Schneeberg in Saxony, and Carinthia.

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* From the Greek, in allusion to its giving out a garlicky smell under the v-pipe.

GOLD.

This metal is only found in the metallic or native state, but is commonly more or less alloyed by other metals.

NATIVE GOLD.

Gediegen Gold W. Or natif H. Br. Bt.

Native Gold is bright yellow, brass yellow, orange yellow, or greyish yellow. It occurs crystallized in the form of the cube and regular octohedron and several of their varieties, but does not possess a lamellar structure; the cube, however has been adopted as the primary form of its crystals, as being the most simple of them; it is also found capillary, ramified, and in grains; likewise in masses weighing several pounds; it is soft, inelastic, flexible, and malleable. Specific gravity 17—19. It is commonly alloyed by copper, silver, and iron in very small proportion.

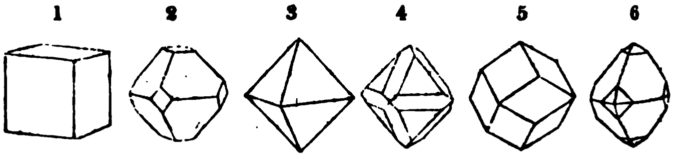
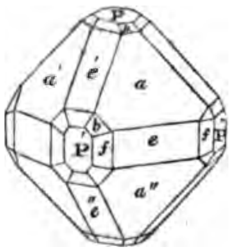


Fig. 1. The cube. Fig. 2. The same, of which the solid angles are replaced by six-sided planes: which are complete in fig. 3, forming the regular octohedron. Fig. 4. an octohedron, with its edges replaced by six-sided planes; which are complete in fig. 5; the rhombic dodecahedron. Fig. 6. an octohedron, of which each solid angle is replaced by four triangular planes, forming on each an obtuse quadrangular pyramid. I possess crystals exhibiting 21 varieties of form, besides 12 others in that compound species of crystallization, expressed by the term macle.



P on P′ or P″....	90.00.00 H
P, P′, or P″ on *a*	125.15.52 ..
——————— *e*	135.00.00 ..
a on *a*′ or *a*″	109.28.16 ..
b on *b*..........	146.26.33 ..
e on *e*′ or *e*″.....	120.00.00 ..

It is found in veins in primitive mountains, but not in the greatest quantity in those which are esteemed to be of the oldest formation; the minerals with which it is associated are the ores of silver, sulphuret of lead, nickel, copper, &c.; but the principal constituent of the veins is quartz; it is found in most of the silver mines of Mexico.

It occurs in granite in Salzburg; at Gardette in France; in gneiss and mica-slate in Mexico; in the latter in Salzburg and the Tyrol; in hornblende rock at Edelfors in Sweden, and at Schlangenberg in Siberia. The mines of Hungary are the most valuable in Europe.

But Gold is more common in alluvial deposits, and in the sands of rivers, into which it is supposed to have been washed, owing to the destruction of the rocks in which it was originally deposited. The sands of the Danube, the Rhine, the Rhone, and some other European rivers, afford small quantities. It is found in the rivers of several islands in the Indian Ocean, as in Java, Japan, Borneo, and the Philippines. It occurs in the rivers and alluvial sands of the southern, middle, and western parts of Africa: it is also found in large quantities in Mexico and Peru: sparingly in some of the rivers of North Carolina in America.

By far the greater part of the Gold now brought into use, is obtained from the rivers of South America; in various parts of which continent, it is also found in veins, and in considerable abundance. In the Vice Royalty of La Plata alone there are 30 gold mines or workings. It is calculated that the annual produce of America is about 30,000 pounds weight.

Helms says, that when a projecting part of one of the highest mountains in Paraguay fell down, about 30 years ago, pieces of gold, weighing from two to fifty pounds each, were found in it.

In Scotland, it is said to have been found in alluvial soil near the Lead hills, in considerable quantity, in the reign of queen 1.11 (467
Elizabeth; also in Glen Turret in Perthshire. In Cornwall, in several of the stream-works of that country, in small quantity; in one instance, a specimen was found of about the weight of 10 guineas: the gold of Cornwall is very dull superficially. Native Gold has lately been found in the refuse of the Prince Regent mine in the parish of North Moulton in Devonshire; it is imbedded in grains and plates in a ferruginous fragmented quartz rock. In Ireland, it was found a few years ago to the amount of 1000 ounces, in alluvial soil at Croghan Kinshela in Wicklow; one mass weighed 22 ounces: it was accompanied by fragments of oxide of iron, wolfram, grey manganese, and quartz: in some of the wolfram it was ramified in threads.

Metallic Gold is sometimes combined in other metalliferous minerals, in various proportions; as in the ores of tellurium, and occasionally in iron pyrites, which thence are termed auriferous. It is also said to have been found in certain sulphurets of zinc, lead, and mercury.

Argentiferous Gold. Electrum. It varies in colour from brass-yellow to silver-white. A specimen from Schlangenberg in Siberia, where it occurs in tabular crystals and imperfect cubes, analysed by Klaproth, yielded 64 of gold and 36 of silver. Neither nitric acid, nor the muriatic superadded, had any effect upon it. Before the blowpipe it fuses into a more or less pale yellow globule.

It occurs with heavy spar, or hornstone, at Schlangenberg in Siberia.

A foliated gold is found in the sand of the river Rhine, intermingled with a sandy ironstone, chromiron, quartzose sand, and micaceous sand. The gold yields according to the analyses of Koelsreuter; 93.5 per cent. of gold, and 6 of silver.

The Gold of Wicklow in Ireland was alloyed by silver.

PLATINA.*

It is found in the metallic state, alloyed with other metals.

NATIVE PLATINA.

Gediegen Platin W. Platine natif ferrifère H.

XXXV 137 Native platina is between steel-grey and silver-white colour, is nearly as hard as iron, and malleable, but is infusible. Specific gravity 15.6. It is commonly found in small grains rarely exceeding the size of a pea, and some instances have lately been observed by G. B. Sowerby in which it has presented a perfectly lamellar structure, with a distinct cleavage, exhibiting four planes forming the solid angle of an octohedron. Nothing is known of its geological situation.

It is said only to have been found in Brazil and Peru: other localities have been given, as St. Domingo, Barbadoes, &c. but upon uncertain authority.

In Brazil it is found in the gold mines of that country, in small tubercular grains, free from tarnish, and with very little lustre, mixed with grains of gold and of palladium; perhaps also with the natural alloy of iridium and osmium. It does not contain any of the magnetic iron sand, or of the minute hyacinths, which always accompany the Peruvian ore. It consists of platina alloyed by very minute portions of gold and of palladium.

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* From a Spanish word, signifying Silver; in allusion doubtless to the colour of Platina.

In Peru, it occurs in small, flattened grains, with occasional indentations, the surfaces of the indentations are generally tarnished; but the other parts have a shining metallic lustre: it is only met with in the Rio del Pinto, in the districts of Citara and Novita in the province of Choco, and near Carthagena in New Grenada. It is found in a magnetic iron-sand, in which are mixed grains of gold, minute hyacinths, and fossil wood: and it is said that the whole is covered by rounded pieces of basalt enclosing olivine and pyroxene. It consists of platina alloyed with small proportions of iron, copper, lead, palladium, iridium, rhodium, and osmium.

The grains of crude platina analysed by Descotils, were accompanied by grains of menachanite and of chromate of iron. Pure platina is now prepared in Paris in leaves as thin as leaf gold.

In the royal museum of Madrid there is a "pepita" (a Spanish term signifying "water-worn mass") of platina, weighing 1 lb. 9 oz. 1 dr. Its larger diameter is 2 inches, four lines and half; its smaller diameter 2 inches. It is of the colour of native silver. Its surface is rough, and is here and there spotted with iron ochre. It was found in the gold mines of Condoto in Choco, South America.

PALLADIUM.*

This metal occurs only in the metallic state, either nearly pure or alloying native platina.

NATIVE PALLADIUM. Wollaston.

8. XXX
/3.

Native palladium occurs in grains apparently composed of diverging fibres; in other respects these grains differ little in external character from those of the native platina, amongst which they are found. Its specific gravity is 11.8. It consists of palladium, alloyed by minute portions of platina and iridium. It is infusible, but on the addition of sulphur it melts with ease;

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* Palladium; from the planet Pallas.

by a continuance of the heat the sulphur is deposited, and a globule of malleable palladium remains. It forms a deep red solution with nitric acid.

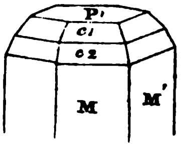
It is only found intermixed with native platina.

IRIDIUM.[*] OSMIUM.

These metals occur together forming a natural alloy; also alloying the native platina of Peru.

ALLOY OF IRIDIUM AND OSMIUM. Wollaston.

(XVII This natural alloy is rarely found crystallized, but mostly in
the form of very small, irregular, and flattened grains, which
139 have a shining metallic lustre, but are of a somewhat paler colour than native platina, and are harder and heavier, their specific gravity being 19.5; they possess a lamellar structure parallel to the terminal planes of the crystals, and are brittle. By fusion with nitre it acquires a dull black colour, but recovers its original colour and lustre, by heating on charcoal.



P on M or M'..	90° 0'
M on M'	120. 0
P on c1	124.42
— — c2	114.57

The above figure and measurements are given on the authority of the Comte de Bournon.

TELLURIUM.[†]

It is found only in the metallic state; in which it is always more or less alloyed by other metals: the purest variety has received the name of Native Tellurium.

NATIVE TELLURIUM.

Gediegen Sylvan W. Tellure natif auro-ferrifère H.

It is of a tin-white colour passing into lead-grey, with a shi-
XV ning metallic lustre; it occurs in minute crystals in the form of
the following figure, and possessing regular cleavages; their
140 direction, owing to the minuteness of the crystals, has not yet

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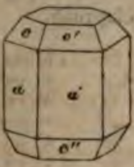
[*] Iridium; Iris, a rainbow; its solutions are variegated,

[†] From the Latin; Tellus, the Earth.

been ascertained, and hence the primary form is unknown: it also occurs in crystalline grains, either aggregated, solitary, or disseminated; it yields to the knife, and is brittle. Specific gravity 5.7—6.1. Exposed to the blow-pipe it melts before ignition, and on increase of the heat it burns with a greenish flame, and is almost entirely volatilized in a dense white vapour, with a pungent acrid odour like that of horse-radish.

It consists of tellurium 92.55, iron 7.2, gold 0.25. Klaproth.



a on *a′*	120°00′
a′ on *c′* or *c″* ...	147.36

It has only been found in Facebay in Transylvania, where it occurs in veins in porphyry, with iron pyrites and quartz.

1. GRAPHIC TELLURIUM. GRAPHIC GOLD.

Schrifterz W. Tellure natif auro-argentifère H.

It is of a steel-grey colour, approaching to tin-white, and is generally splendent, but is sometimes slightly tarnished externally. It occurs crystallized in the form of a right rhombic prism of 107° 44′ and 72° 16′ by measurements taken with the reflective goniometer on the natural planes; the crystals are commonly modified on the edges and angles, are generally very minute, and so arranged as to give to the whole row the appearance of a line of Persepolitan characters; it yields easily to the knife, and is brittle. Specific gravity 5.7. Before the blow-pipe on charcoal, it fuses into a dark grey metallic globule, which finally is brilliant and malleable.

8. CLXV

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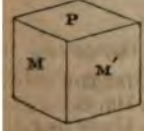
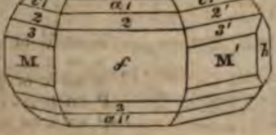
It consists of tellurium 60, gold 30, silver 10. Klaproth.

Primary.





P on M or *f* ..	90°00′
M on M′	107.44
P on *a* 1	141.30
— — *a* 2	129.12
— — c 1 or *c* 1′	151.40
— — c 2 — *c* 2′	136.42
— — *c* 3 — c 3′	132.45
M on *h*........	126. 8
f on *h*........	90. 0

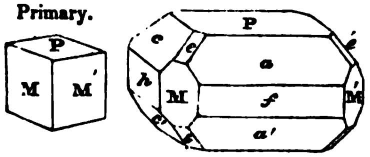
It has only been found at Offenbanya in Transylvania in veins in porphyry, with quartz, calcareous spar, native gold, iron pyrites, &c.

2. YELLOW TELLURIUM.

Weiss Sylvanerz W. Tellure aurifère & plombifère H.

XIV

It is of a silver-white, passing into yellow and grey of different shades. It occurs in very small but well defined crystals, of which the primary form is a right rhombic prism of 105° 30′ and 74° 30′ by the reflective goniometer: it possesses a bright metallic lustre; it is soft, and somewhat sectile. Specific gravity 10.6. It consists of tellurium 44.75, gold 26.75, lead 19.5, silver 8.5, sulphur 0.5. Klaproth.



M on M ...	105°30′
P on M or *f*	90.00
M on *f*	142.30
— — *h*	127.30
a on *f*	161.30
c on *h*	126.55
— — *a*	123.30

For the above figure and measurements I am indebted to H. J. Brooke, Esq.

It has been found only at Nagyag in Transylvania, in irregular veins in porphyry, with gold, native arsenic, sulphuret of manganese, &c.

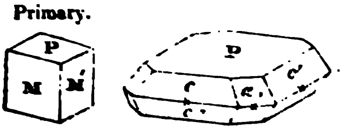
3. BLACK TELLURIUM.

Nagyagererz W. Tellure natif auro-plombifère H.

XVII

It is of a colour between iron-black and dark lead-grey: it is found crystallized in the form of very small and nearly tabular crystals, of which the primary form appears to be a right square prism: it yields easily to the knife, is sectile, and in thin laminæ is flexible. Specific gravity 8.9. Before the blow-pipe it melts and evaporates for the most part, giving out a dense vapour, which partly concretes on the charcoal in the form of a reddish-brown powder.

It consists of tellurium 32.2, lead 54, gold 9, silver 0.5, copper 1.3, sulphur 3. Klaproth.



M on M or x on x....	90°00′	c.g.
x′ on x or x	135.00	..
P on *a*	118.35	
P on c or c′.	110.00	c.g.

It has only been found at Nagyag in Transylvania, accompanying the yellow tellurium.

ANTIMONY.

It is found in the metallic state; its ores are not numerous.

NATIVE ANTIMONY.

Gediegen spiesglas W. Antimoine natif H. Br. Bt.

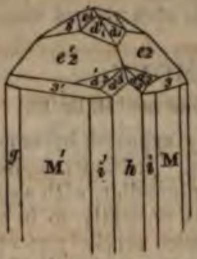
It is of a tin-white colour, but by exposure becomes externally tarnished yellowish or blackish. It occurs reniform and amorphous; the structure is perfectly lamellar, with a splendent metallic lustre in one direction, less perfectly so in other directions, which hitherto have not been precisely ascertained; it yields to the knife, is somewhat sectile, and easily frangible. Specific gravity 6.7. A specimen from Andreasberg, analysed by Klaproth, yielded 98 of antimony, 1 of silver, and 0.25 of iron. Before the blow-pipe it melts easily, and volatilizes in the form of a grey inodorous vapour; if the melted button be allowed to cool slowly, it becomes covered with white brilliant acicular crystals. A very minute bead of silver generally remains after the antimony has been volatilized: when alloyed with a small proportion of arsenic, the vapour has the odour of garlic. E. CIII 144

It occurs in veins traversing gneiss in Dauphiné, with the ores of antimony and cobalt; at Andreasberg in the Hartz; at Allemont near Grenoble in France, and is generally coated by antimony-ochre. At Sahlberg in Sweden, in reniform masses disseminated in calcareous spar. It is also found in Mexico; and in Connecticut, North America, with sulphuret of antimony. An arsenical variety is found at Allemont.

GREY ANTIMONY. SULPHURET OF ANTIMONY.

Grau Spiesglaserz W. Antimoine sulfuré H.

It is of a light lead-grey colour, but is sometimes dull externally, often iridescent. It occurs massive, disseminated, and crystallized in rhombic prisms, variously modified and terminated; the crystals are sometimes closely aggregated laterally; it yields to mechanical division readily in one direction, namely, at right angles to the plane *h* of the following figure, with brilliant surfaces. The primary form appears to be a right rhombic prism of about 88° 30′ & 91° 30′; it is soft, and very flexible. Specific gravity 4.3. That of Cornwall consists of antimony 74.06, sulphur 25.94. J. Davy. When placed E. CXVI 145 in the flame of a candle it melts; before the blow-pipe it is almost totally evaporable in the form of a white vapour, with a sulphureous odour.



M' on M	88°40'
M' on $e'2$ or M on $e2$	145.30
M' or M on h	134.20
M' on i' or M on i	171.40
M' on g	173.00
$e'2$ on $e2$	108.30
h on $e'2$ or $e2$	125.30
— — i' or i	161.30

It occurs in veins traversing gneiss in Auvergne in France: in granular limestone, at Offenbanya in Hungary, with ores of copper, zinc, and lead: in transition rocks in the Hartz: in Bohemia, Salzburg, and several other European countries.

In Scotland, at Glendinning in Dumfries-shire in veins traversing transition rocks.

Acicular Sulphuret of Antimony. Antimoine sulfuré aciculaire H. It differs from the foregoing chiefly in the indistinctness of its crystals, and also in their arrangement; either they intersect each other variously, or radiate from a common centre.

CCLXV It is commonly found with the preceding.

(468) In Cornwall it occurs in St. Stephen's, at Port Isaac near Padstow; and in Huel Boys in Endellion, in veins traversing those of copper and tin: it has not been found in the east and west veins of that county.

Plumose Sulphuret of Antimony. Antimoine sulfuré capillaire H. It is of a dark-lead grey colour, and is often iridescent on the surface; it occurs in very minute capillary crystals, investing the surface of other minerals as with a downy appearance; or the crystals are interlaced and adhere together, so as to appear like a crust. It is opaque, brittle, and soft. Specific gravity 3.5. Before the blow-pipe, it melts into a black slag, after giving out a vapour, which when condensed, appears in the form of a white and yellow powder.

It is not common, but has occurred with the other ores of antimony, as in Huel Boys mine in Cornwall.

.CXXI *Sulphate of Antimony comb^d with Nickel.*

146

Compact Sulphuret of Antimony. Antimoine sulphuré compact H. It is of a light lead-grey colour; the fracture is fine-grained and uneven with a glistening lustre; it occurs massive and disseminated; it is soft and easily frangible. Specific gravity 4.3.

It is found in Saxony, Hungary, France, &c. in Siberia, in Chili, &c.

In Cornwall in Huel-Boys mine not far from Padstow.

RED ANTIMONY.

Rothspiesglaserz W. Antimoine oxydé sulfuré H. Antimoine Rouge Br.

E.LXI
14

It is by reflected light of a cherry-red colour, by transmitted light of a crimson colour, but is commonly tarnished externally with a brownish or bluish tinge, or is irridescent. It occurs in very fine diverging, or interlaced acicular crystals, and amorphous: one of these minute crystals afforded by the reflective goniometer perfect measurements of 90° & 135°, inducing the conclusion that the crystal is a right square prism, having the edges replaced; it has a shining lustre, is translucent and brittle. Specific gravity 4.—4.6. It consists of 67.5 antimony, 10.8 oxygen, 19.7 sulphur. Klaproth. Before the blow-pipe it melts and evaporates, giving out a sulphureous odour.

It occurs in veins chiefly in primitive rocks, with the sulphuret of antimony, &c. as in Saxony, at Allemont in France; in Tuscany, Hungary, and Transylvania.

WHITE ANTIMONY. OXIDE OF ANTIMONY.

Weiss spiesglaserz W. Antimoine oxydé H. Bt. Antimoine blanc Br.

E.XLVII
14.
CCCCXL
(46

It is of a white, yellowish-white, or greyish colour; it occurs crystallized in tabular and acicular crystals, in diverging groups; it more rarely occurs massive; it yields to mechanical division parallel to the sides of a rhombic prism of 137°.43′, and 42°.17′, by the reflective goniometer, but the principal cleavage is parallel to the lesser diagonal of the prism; it possesses a shining lustre between pearly and adamantine; it is translucent, soft, and heavy. It consists of 86 of oxide of antimony, 3 oxide of antimony with oxide of iron, and 8 of silex. Vauquelin. It melts very easily before the blow-pipe, and is volatilized in the form of a white vapour.

It is usually found with the other ores of antimony. It occurs at Przibram in Bohemia, and at Braunsdorf in Saxony, on sulphuret of lead; the acicular variety is found at Malazka in Hungary, in clay containing sulphuret of antimony, and at Allemont in Dauphiné on native antimony.

ANTIMONIAL OCHRE.

Spiessglanzocher W. Antimoine oxydé terreux H.

It is of various shades of yellow passing into brown; it usually occurs investing the ores of antimony; it is dull, soft, and brittle, with a fine earthy fracture, and is heavy.

It is found in Bohemia, Hungary, Transylvania, &c.

In Cornwall, it occurred investing compact sulphuret of antimony, in Huel Boys near Padstow; and near Port Isaac.

LEAD.

The ores of lead are very numerous; it has been found in the metallic state, in small masses in the lava of the Island of
CCLXXVIII Madeira, forming the *Native Lead* of some mineralogists; it is
(470) also said to have been found in the same state in Ohio, North America, near the mouth of the Au Glaize river, in slender prismatic masses in crystallized galena.

GALENA. SULPHURET OF LEAD.

Bleischweif W. Plomb sulfuré H. Br. Galène Bt. Lead Glance. J.

XXIV
(471) It is externally of a lead-grey colour, occasionally blackish-grey; and is sometimes irisated superficially. It occurs crystallized in the form of the cube and regular octohedron, and in
XXXI some of their varieties; the structure is lamellar; it readily
(472) admits of mechanical division parallel with the planes of the cube, which therefore is the form of the primary crystal; the fractured surfaces possesses a brilliant metallic lustre; it also
LXXVI occurs in amorphous masses, possessing a straight or curved lamellar structure; it is soft, sectile, and easily frangible. A spe-
(473) cimen from Durham, analysed by Dr. Thomson, yielded lead 85.13, sulphur 13.02, and iron 0.50. Before the blow-pipe, it first decrepitates and flies, then melts emitting a sulphureous odour, and a globule of metallic lead remains.

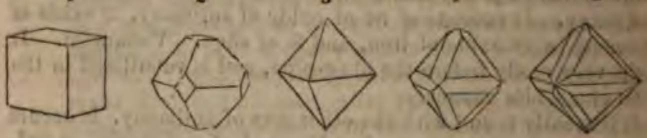
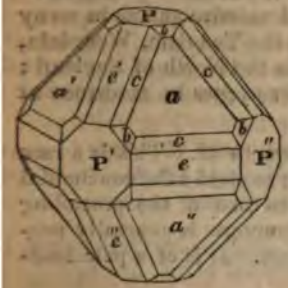


Fig. 1. The primary; a cube; Fig. 2. The same, of which the solid angles are replaced by triangular planes, forming the passage into the regular octohedron, fig. 3, in which those planes are complete. Fig. 4. The octohedron, having the edges replaced. Fig. 5. In this each edge of the

octohedron is bevelled, or replaced by two planes: the solid angles are mostly replaced.



P on P' or P''	90. 0. 0 H
$P\,P'$ or P'' on $a\,a'$ or a''	125.15.52 ..
P on b	154.45.38 ..
P or P' on e', or P' or P'' on e	135.00.00 ..
a on a' or a''	109.28.16 ..
—— b, b, or b	150.30.14 ..
—— c or c	164.12.24 ..
a or a' on e', or a or a'' on e	144.44. 8 ..
e on e	160.31.44 ..

It occurs in beds and in veins in primitive and secondary mountains, and is commonly associated with iron and copper pyrites, the ores of zinc, and sometimes with those of silver and of antimony.

It occurs in veins in granite and other primitive rocks in Massachusets N. America, and in the Vosges in France, and in Spain; in gneiss in the Saxon Erzgebirge; in primitive limestone at Sala in Sweden; in clay-slate in Bohemia. In floetz limestone in N. & S. America, and other countries. It occurs in most European countries; sparingly in Asia.

In England, perhaps the greatest known depository of this valuable ore, it occurs in veins, both numerous and large, traversing (transition or early) secondary limestone in Derbyshire, Durham, and Northumberland; in these veins it is accompanied by fluor, calcareous spar, pearl spar, quartz, sulphate and carbonate of barytes, iron pyrites, spathose iron, blende, calamine, &c. It is also found in small quantity in the same limestone near Bristol. In veins in clay-slate in several mines in Cornwall, and in Devonshire. In Shropshire it occurs in slates and schistose rocks, and in most of the counties of Wales; in limestone in Flintshire.

In Scotland, in the Lead hills in Lanarkshire, and Wanlock head in Dumfries-shire, with other ores of lead, and with iron pyrites, calcareous spar, heavy spar, &c. in veins in transition rocks: at Monaltrie in Aberdeenshire in granite; at Strontian in Argyleshire in gneiss; at Cumberhead in Lanarkshire in sandstone; in the Lothians and Fifeshire in the sandstones of the coal-formation; in limestone in Isla; in gneiss in Coll.

Granular Galena. Steel-grained Galena. Plomb sulfuré granulaire H. It consists apparently of small crystalline plates irregularly disposed in regard to each other. The fracture is granular and uneven; the lustre is glistening.

It occurs with crystallized and massive galena in many of the veins of this country, as in the Teesdale, Weardale, Allendale, and Aldstone mines in the North of England; and with black cobalt and copper pyrites in sandstone at Alderley Edge in Cheshire.

Compact Galena. Plomb sulfuré compacte H. This is a rare variety. It is sufficiently compact to yield a flat conchoidal fracture, with a lustre inferior to that of the preceding variety; but a finely granular structure is generally perceptible by the assistance of a glass. It is of a pale lead-grey colour.

Specular Galena. Slickensides. Plomb sulfuré speculaire H. It generally consists of an extremely thin coating of lead on quartz or some other substance, and exhibits an appearance of polish, and a lustre which procured for it the name CXCII of Slickensides or looking-glass lead ore.

(474) It is found principally in some of the mines of Derbyshire. The quartz on which it is found forms the veinstone, and adheres to both walls of the vein, and when these veinstones meet, each being coated thinly by lead, they are readily separable by the pick of the miner; but the consequence sometimes is, that fragments fly off with loud explosions, as was the case in the Gang mine in Cromford level: it is also found at Ecton in Staffordshire, and Allenheads in Durham.

Antimoniferous or Antimoniated Galena. Plomb sulfuré antimonifère H. It is generally found in reticulated masses, which appear to consist of elongated cubes variously inter- XXII secting each other; sometimes investing common crystal- (475) lized galena, but is generally of a darker lead-grey colour. It is supposed to form the passage into the substance described under the name of white silver.

It occurs in the Dufton mines of the North of England.

Argentiferous Galena. It is generally of a much paler lead-grey than common galena, and the crystals often approach a tin-white or even a silver-white colour. It occurs in octohedrons, variously modified, also massive.

It is found in the mines of the north of England, and abundantly in the silver mines, as they are termed, of Beeralstone in Devonshire.

Common Galena generally contains a very small proportion of silver. But the proportion varies greatly in those which may be strictly termed argentiferous, and which are worth smelting for the silver they contain. Eleven and a half ounces of silver to the ton of ore is the general average of the lead of the north of England. That of Huel Pool in Cornwall yielded 60 ounces; that of Guarneck (Garres ?) mine near Truro 70 ounces. One ton of the ore of the South Hoo mine, adjoining Beeralstone in Devonshire, lately yielded 135 ounces of pure silver.

Supersulphuret of Lead. It is earthy, of a bluish grey colour, and so highly inflammable as to take fire and burn on being held in the flame of a candle.

It occurs in the Dufton lead mines.

The whole of the lead mines of Great Britain produce annually from 45 to 48,000 tons of smelted lead, which is principally obtained from the sulphuret.

BLUE LEAD.

Blau Bleierz W. Plomb sulfuré prismatique epigène H. Plomb bleu Br. Plomb noir Bt.

It is of a colour between lead-grey and indigo-blue; it occurs massive, likewise in six-sided prisms, which sometimes are narrower near the terminations than across the middle, and which are superficially dull and rough; the fracture is even, passing into fine-grained uneven, and flat conchoidal, with a glimmering metallic lustre; it is soft and somewhat sectile, and easily frangible. Specific gravity 5.4. Before the blow-pipe, it fuses, emitting a pungent sulphureous vapour, and is reduced to the metallic state. The interior of some crystals from Pullaouen, as I am informed by G. B. Sowerby, have been found to consist of the phosphate of lead, leading to the conclusion that the blue lead is derived from the phosphate by some natural process.

E. CLI
149

It has been found in Zschoppau in Saxony and Huelgöet in France, accompanying carbonates of lead and of copper.

Some specimens in six-sided prisms terminated by pyramids, and which have been termed Blue Lead, have lately been brought from Cornwall; these commonly have the external appearance of ordinary sulphuret of lead; internally they seem often to consist of fibrous galena, occasionally mixed with a translucent substance, of a rich brown colour by transmitted light, and greatly resembling some varieties of phosphate of lead, or the prisms consist almost wholly of this substance, which merely on the surface appears to have passed into sulphuret of lead: other specimens consist of remarkably compact galena.

BOURNONITE.* TRIPLE SULPHURET.

Endellione, Bournon. Schwarz Spiessglaserz W.

It is of a colour approaching to steel-grey, sometimes completely so externally, with a shining lustre; but occasionally,
though rarely, the crystals are superficially of a dull lead-grey,
with a tinge of black: it occurs crystallized in the form of
XXXV rectangular prisms variously modified and partly imbedded,
(476) rarely solitary; the structure is perfectly lamellar, affording
brilliant planes by mechanical division parallel to the lateral
planes of a right rectangular prism and both its diagonals, thus
offering to our choice also a rhombic prism, of about 93° 30′ and
XXXVI 86° 30′ as the primary crystal, in which case the planes $d1$ and
$d1'$ would be primary planes; but the right rectangular prism
(477) is preferred, because the planes $d1$ and $d1'$ are more frequently
striated than those marked M and M′; the cross fracture is uneven or flat conchoidal, with a brilliant metallic lustre; it is very brittle, and yields to the pressure of the nail. Specific gravity 5.7. That of Cornwall consists according to Hatchett, of lead 42.62, antimony 24.23, copper 12.8, iron 1.2, sulphur 17. It is estimated by Smithson to be a composition of sulphuret of lead 47.41, sulphuret of antimony 34.23, sulphuret of copper 16, sulphuret of iron 2.60. Before the blowpipe it generally splits with decrepitation, then melts, emitting a white sulphureous vapour, after which there remains a crust of sulphuret of lead, enclosing a globule of copper.

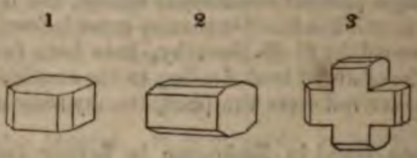


Fig. 1. A rectangular prism, of which the lateral edges are replaced: converting the crystal into an eight-sided prism. In fig. 2, two opposite edges of each terminal plane are replaced by planes inclining on the terminal planes, so as to reduce them greatly. Fig. 3, a macle, in which two crystals similar to fig. 3, but elongated, cross each other.

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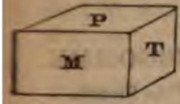
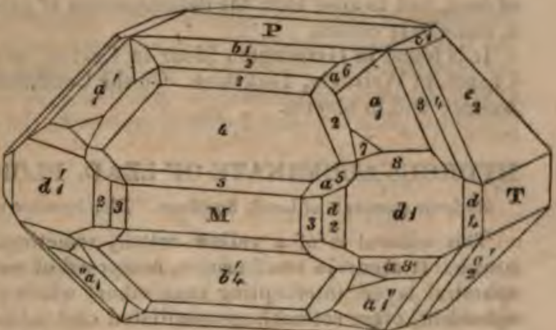
* Bournonite, in honor of the Comte de Bournon, who first described this mineral, and who gave it the name of Endellione, from the parish in Cornwall in which it was found.

Primary.





M on T	90°00′	*a*1 on *a*3	165.00
P on M or T	90.00	— — *a*4	150.20
— — *a*1 or *a*1′	146.48	— — *a*5	147.35
— — *b*1	175.50	— — *a*6	179.24
— — *b*2	165.00	— — *a*7	164. 5
— — *b*3	154.00	— — *a*8	168.00
— — *b*4	136.30	— — *b*4	152.36
— — c1	173.15	— — c2	146.35
— — c2	136. 9	*b*4 on *b*4′	87.30
M on *a*1 or *a*1′	114.00	— — *d*1	120.20
— — *a*5	143.20	— — *a*5	151.30
— — *b*2	115.15	— — c2	119.22
— — *b*4 or *b*4′	133.40	c2 on c2′	88.00
— — *b*5	151.52	*d*1 on *a*1 or *a*1″	123.15
— — *d*1 or *d*1′	136.48	— — *a*5	149. 5
— — *d*3 or *d*3′	154.48	— — *a*7	132.52
T on *a*1	109.50	— — *a*8 or *a*8′	142.40
— — c2	134.00	— — *d*1	93.40
— — *d*1	133.00	*d*1 on *d*2	168.33
*a*1 on *a*1″	66.30	— — *d*3	161.58
— — *a*2	175.10	— — *d*4	172.15

It was first found in Huel Boys in the parish of Endellion in Cornwall, with grey antimony and brown blende in veins in clay-slate; and since at Ratisbon, at Servoz in Chamouni, and at Kapnick in Transylvania, with blende, galena, and iron pyrites; also in Saxony, in the Hartz, in Siberia, and in Peru.

NATIVE MINIUM.

Native Minium, Smithson. Plombe oxydé rouge H.

It is of a scarlet colour; it occurs amorphous and pulverulent, but when examined by the lens, exhibits a crystalline structure. Before the blow-pipe on charcoal it is first converted into litharge, and then to metallic lead. It is supposed to be an oxide CCL XXV 4 of lead, and to arise from the decomposition of galena, in which it commonly occurs.

It is found in Grassington Moor in Craven, and at Grasshill Chapel, in Weirdale, Yorkshire. On the Continent near Badenweiler: and in Siberia.

HYDROUS ALUMINATE OF LEAD. PLOMBGOMME.

Hydrous aluminate of Lead, Smithson. Plombgomme of the French.

CLXI 150 This mineral is of a yellow colour, sometimes tinged with brown. It occurs in small masses, composed of many concentric spherical layers intercepting each other, which are externally splendent, often resembling mamillated chalcedony, and sometimes possessing a degree of pearly lustre on their inner surfaces, which also occasionally are irisated. The concentric layers, when broken across, are without splendor, and rarely present a slight appearance of a radiating texture, but are without any regular crystalline structure. The mass is translucent on the edges. It is considerably heavy. Analysis by Berzelius, oxide of lead 40.14, alumine 37.00, water 19.90, sulphuric acid 0.20, oxides of manganese and iron 1.80, silex 0.60.

When suddenly heated it decrepitates violently; when slowly heated it becomes white and opaque, but does not finally melt; by the addition of borax it melts into a colourless transparent glass, but without reducing the lead, which however is effected by the addition of nitre.

It is found only at Huelgoet near Pullaouen in Brittany.

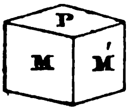
CARBONATE OF LEAD.

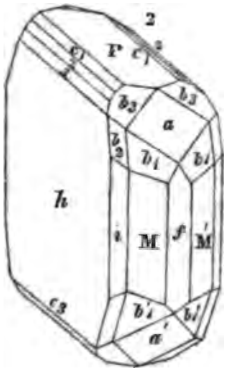
LIII (479) Weiss Bleierz W. Plomb carbonaté H. Bt. Plomb blanc Br. White Lead-ore J.

It is white, yellowish and greyish-white, of various shades of
LIV (480) grey, and occasionally light brown. It occurs in tabular crystals,
in six-sided prisms variously terminated, and in other macled
crystals of different forms. It cleaves in several directions,—
CLXXXVI as parallel to the planes P M and M′ of the following figures,
(481) thereby affording for its primary form a right rhombic prism of
117° and 63°; also to the plane *h*, which is parallel to its lesser
XXIX diagonal; likewise parallel to the planes *c* 1 *c* 1: some of its
(482) macled crystals, especially those in the form of six-sided prisms,
XC (483) are not yet understood: the lustre of the planes produced by
cleavage is somewhat adamantine; the cross fracture is small
XCI (484) conchoidal with a resinous lustre; it varies from transparent to
CXLII opaque; when transparent it is doubly refractive in a high de-
(485)

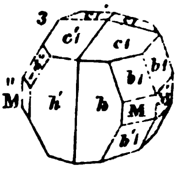
gree; it is very brittle. It also occurs massive. Specific gravity 6.72. It consists of oxide of lead 82, carbonic acid 16, watér 2. Klaproth. Before the blow-pipe it decrepitates, becomes yellow, then red, and is immediately reduced to the metallic state; it effervesces in dilute muriatic acid, especially if warm.

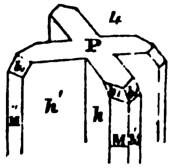
1





Macles.





M on M'	117°00'	*a* on *a'*	67.12
P on M or M'..........	90.00	*a* on *b*1 or *b*1	149.00
— — *a*	149.14	*b*1 on *b*1	130.00
— — *f*	90.00	— — *b*2	162. 6
— — *h*	90.00	— — *b*3	160.32
M or M on *a* or *a'*	115.30	*c*1 on *c*1	140.20
M or M' on *f*	148.32	— — *b*1	134.00
M on *b*1 or M' on *b*1' ..	144.15	— — *b*3	151.00
— — *b*2 — — — *b*2 ..	146.12	*h* on *c*1	109.16
— — *b*3 — — — *b*3 ..	124.42	— — *c*2	125.43
— — *c*1	100.24	— — *c*3	145.16
M on *h*	121.26	— — *i*	151.21
— — *i*	150.00	M on M'' (macles)	125.30

It occurs in veins in primitive and secondary countries, accompanying galena and other ores of lead, also several of the ores of copper, iron, manganese, and zinc. The crystals occasionally appear to be coated by sulphuret of lead.

It is pretty abundant in several European countries; it occurs in the Hartz, in Saxony, Bohemia, Silesia, Hungary, &c.; also in Siberia, in Chili, and in Pennsylvania.

In England, it occurs in Huel Penrose lead-mine, in Pentire mine near Padstow, and in Huel Golden near St. Aguess, in Cornwall; in Beeralstone mine in Devonshire; at Alston in Cumberland; at Dufton in an old working, coating fragments of a rock, &c. and at Allonhead and Teesdale in Durham, and in Derbyshire. In Scotland in the Lead hills, at Wanlock head in stalactites.

Lead grey, A. The grey colour is merely superficial, and is supposed to exhibit the partial conversion of the carbonate into the sulphuret of lead.

Blue and Green, A. Plomb carbonaté cuprifère H. The colour arises from carbonate of copper, and is either superficial, or pervades the crystal or mass; in the first, it is owing to the deposition of copper, in the latter to its infiltration.

It is found at Wanlock head and the Lead hills in Scotland.

Acicular Carbonate of Lead. Plomb carbonaté aciculaire H.
LV (486) It consists of very minute fibres or crystals, either single or diverging, sometimes aggregated laterally. It is white, greyish-white, brown, and black, and is either transparent, translucent, or opaque.

It occurs with the preceding variety.

It has been found in several of the mines of Cornwall, as in Huel Alfred, Huel Ann, and in Pentire near Helston; in the latter of remarkable beauty and brilliancy, of a snow-white and nearly opaque: also at Snailbach in Shropshire. The black variety occurs at Fairhill and Flow edge in Durham: also in the Lead hills in Scotland.

Scaly Carbonate of Lead. It is of a whitish-grey colour, with a glimmering lustre, being composed of thin lamellæ or scales.

It occurs at Allonhead in Durham.

Earthy Carbonate of Lead. Bleierde W. Plomb carbonaté terreux H. Indurated and friable earthy Lead-ore J. It is of a grey colour, occasionally with a tinge of green, yellow, or red, also reddish-brown. It occurs massive, disseminated, and pulverulent. The fracture of the massive is fine-grained and uneven, rarely flat conchoidal; it is commonly dull and opaque, and sometimes friable, and is soft and heavy.

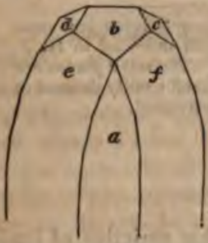
It occurs in several European countries, commonly with the preceding varieties.

In England, it occurs massive and of a grey colour in Grassfield mine near Nent head, Durham, and at Wirksworth in Derbyshire; friable, of a dark reddish brown at Aldstone moor: in Derbyshire. In Scotland, both varieties occur at Wanlock head and the Lead hills.

SULPHATO-CARBONATE OF LEAD.

Var. of Rhomboidal Carbonate of Lead. Bournon. Sulphato-carbonate of Lead. H. J. Brooke.

Its colour varies, being either whitish, bluish, or greenish grey, sometimes approaching to apple-green. The crystals are seldom distinct, always minute, and aggregated lengthwise, presenting a character approaching to fibrous. They may be cleaved at least in two directions, in one with greater ease than the other; the primary form may be considered as being a right oblique angled prism, of 59°.15′, & 120°.45′; but owing to the minuteness of the crystals the relations of the planes apparent in the following figure, to those of the primary crystal, have not been ascertained; it does not however exhibit any one of the primary planes. It is not so hard as carbonate of lead. Specific gravity 6.8 to 7. Effervescence while dissolving in nitric acid scarcely perceptible. It consists of 53.1 of sulphate, and 47.9 of carbonate of lead. H. J. Brooke.



a on *b*	111.° 0′
b on *b* over summit	130. 5
a on c	106. 45
—— *d*	73. 45
—— *e*	123. 20
c on *f*	133. 0
d on *e*	136. 54

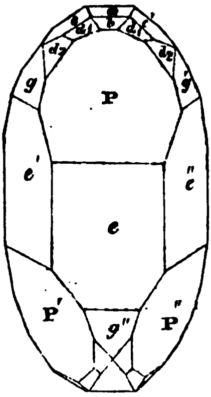
Before the blow-pipe on charcoal, it fuses into a globule which is white when cold, and is nearly reduced into metallic lead.

It occurs among other varieties of lead ore at the lead hills in Scotland.

SULPHATO-TRI-CARBONATE OF LEAD.

Var. of Rhomboidal Carbonate. Bournon Cat. Sulphato-tri-carbonate of Lead. H. J. Brooke.

It occurs both in rhomboidal and prismatic crystals. The colour of the rhomboidal is pale greenish, or yellowish, or brownish: but when very minute they are colourless and transparent. The prismatic varieties are colourless, or of various shades of pale yellow. The primary form is considered to be an acute rhomboid of 72°.30′ & 107°.30′; the only cleavage that has been observed is perpendicular to the axis of the acute rhomboid, and parallel to the plane *a* of the following figure. This rhomboid passes, by the replacement of all its solid angles, into a six-sided prism; but it is also subject to modifications producing three or four varieties of more obtuse rhomboids. The natural planes of all, except the most minute crystals are more or less rounded, and consequently afford imperfect reflections. Specific gravity 6.3 to 6.5. It is not so hard as the sulphate of lead, but is harder than the cupreous sulphato-carbonate. Analysis by H. J. Brooke, 27.5 sulphate of lead, 72.5 carbonate of lead.



P on P′ or P″	107°.30′
P′ on P″	72. 30
P on *a*	111. 30
a on *g*	111. 30
—— *d*1	131. 58

For the annexed figure and measurements I am indebted to H. J. Brooke, Esq. The small planes are not in general sufficiently defined to admit of measurement.

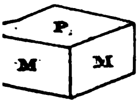
This substance also occurs among other varieties of lead-ore from the lead hills, Scotland.

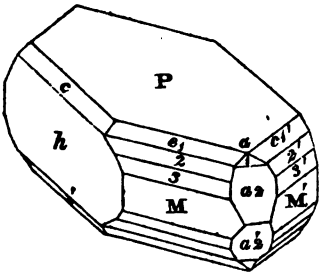
CUPREOUS SULPHATO-CARBONATE OF LEAD.

Cupreous Sulphato-Carbonate of Lead. H. J. Brooke.

This substance occurs in crystals, varying from blue to dark greenish blue colour, generally very minute, and appearing sometimes in small bunches, radiating from their common point of attachment to the matrix. It yields to mechanical division parallel to all the planes of a right rhombic prism of 95° & 85°, which therefore is the primary form of its crystals: it also cleaves in a direction parallel to the shorter diagonal of the prism, i. e. to plane *h* of the following figure; the planes M and M′ often appear as a dihedral termination to prismatic crystals. It is not so hard as carbonate of lead, but is harder than the sulphato-tri-carbonate. Specific gravity about 6.4. It consists of 55.8 sulphate of lead, 32.8 of carbonate of lead, and 11.4 of carbonate of copper, if the carbonate of copper be chemically combined and not accidental.

Primary.





M on M'	95°00'
P on M or M'	90.00
— — *a*2	108.00
— — *c*	126.00
— — *e*1 or *e*1'	126.00
— — *e*2 or *e*2'	115.30
— — *h*	90.00
M on *e*1	144.00
— — *h*	132.30
*a*2 on *a*2'	143.42
— on *e*2	140.40
c on *h*	144.30
*e*1 on *e*1'	108.00
*e*2 on *e*2'	128.35

The above figure and measurements were presented to me by H. J. Brooke, Esq.

It is found, together with the two preceding varieties, among specimens of lead-ore from the Lead hills in Scotland.

MURIO-CARBONATE OF LEAD.

Hornblei W. Plomb corné Br. Plomb muriaté Bt. Corneous Lead-ore J.

This rare mineral has been found of a greyish colour passing into a wine-yellow, and crystallized in four-sided rectangular prisms, either perfect, or having the lateral and also the terminal edges replaced: also in rectangular prisms terminated by pyramids. The structure is described as being lamellar, with natural joints parallel to all the planes of a square prism; the cross fracture as being conchoidal, with a splendent adamantine lustre; it is transparent or translucent, very soft, sectile, and easily frangible. Specific gravity 6. It is composed of oxide of lead 83.5, muriatic acid 8.5, and carbonic acid 6.5. Klaproth. Before the blow-pipe, on charcoal, it melts into an orange-coloured globule, recticular externally when solid; when again melted it becomes white, and on the increase of the heat, the acid flies off, and minute globules of lead remain behind.

CCCX(
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CCC
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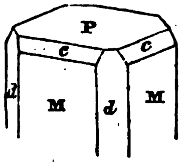


M on M	90.00'
M or M on *d*	135.00

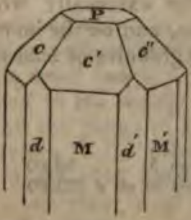
The above figure and measurements of this rare mineral were taken from a crystal in the British Museum by H. J. Brooke, Esq.

It occurred at Hausbaden near Badweiler in Germany; and many years since in Cromford level near Matlock in Derbyshire, accompanied by carbonate and sulphuret of lead and fluor, on cawk; on a specimen in the possession of Mr. Desse, the crystals are in the form of rectangular prisms, terminated by four-sided pyramids, and the prisms are macled, crossing each other at right angles. A green variety is described as occurring in crystals on galena in Southampton, Massachusetts, North America.

PHOSPHATE OF LEAD.

Grün bleierz W. Plomb phosphaté H. B.

It is of various shades of green, yellowish green, and yellow:
XXXIV it occurs crystallized in the form of a six-sided prism generally
(489) modified on the edges; the prism yields to mechanical division parallel to all its planes; also to all the planes *c c′ c″* replacing its terminal edges, thereby affording cleavages parallel to all the
LVIII planes of a double six-sided pyramid; we may however adopt
(490) as its primary form, the regular six-sided prism, as being the more simple figure: it varies from transparent to slightly trans-
XLIII lucent, yields to the knife, and is easily frangible, but less so
(491) than sulphate or carbonate of lead. It also occurs botryoidal, reniform, and massive. Specific gravity 6.4. It consists, according to Klaproth, of 80 oxide of lead, 18 phosphoric acid, and 1.62 muriatic acid. Before the blow-pipe, on charcoal, it usually decrepitates, then melts, and on cooling forms a polyedral globule, the faces of which present concentric polygons; if this globule be pulverized and mixed with borax and again heated, a milk-white enamel is the first result; on continuance of the heat the globule effervesces, and at length becomes perfectly transparent, the lower part of it being studded with globules of metallic lead.



M on M′	120°00′
P on M or M′ ...	90.00
M or M′ on d′	150.00
M on c′ or M′ on c″	131.45
P on c or c″	138.30
c′ on c or c″	110. 5

It is found in lead veins in primitive and secondary rocks, and occurs in those of the Hartz, Saxony, Bohemia, &c. and in

Siberia; in the Perkiomen lead mine in Pennsylvania, and in Massachusetts, North America.

In England, it occurred in Huel Penrose lead mine near Helston, and in Huel Golden mine near St. Agnes in Cornwall; at Aldstone in Cumberland; Allonhead, Grasshill, and Teesdale in Durham; at Surside mines in Netherdale in Yorkshire; and in Derbyshire.

In Scotland, with other ores of lead in the Lead hills, and at Wanlock head. In Ireland, at Lord Londonderry's park, County of Down.

Brown Phosphate of Lead. This variety differs so little from the preceding, except in being of a greyish brown colour, as scarcely to merit separate mention: in respect of analysis the proportions of the constituents vary very little. It occurs in minute fasciculated six-sided prisms, of which the sides are often convex. Before the blow-pipe it melts into a globule, which on cooling concretes into a radiated mass.

It is found in Bohemia, near Schemnitz in Hungary, in the Bannat, Saxony, and at Huelgoet and Poullaouen in Lower Brittany; also in Mexico.

Arseniated Phophate of Lead. Plomb phosphaté arsenifère H. Conchoidal phosphate of Lead. J. It is of various shades of yellow and greenish-yellow: it occurs in all the forms common to phosphate of lead, the sides of the prism being mostly convex; also mamillated. Analysis of that of Roziers by Klaproth, oxide of lead 76, phosphoric acid 13, arsenic acid 7, muriatic acid 1.75, water 5.

E. CXL
/51

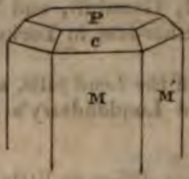
ARSENIATE OF LEAD.

Plomb arsenié H.

Its common colour is pale yellow, whence it passes into hair-brown, but is said to have been found of a grass-green colour? It occurs in hexahedral prisms, either perfect, or having the terminal edges replaced, and in small crystals fasciculated so as to assume the general appearance of a six-sided prism, of which the sides are convex; also mamillary and compact. The structure of the crystals is lamellar, yielding to cleavage parallel to the planes of the regular six-sided prism; it is translucent, rarely transparent, but when transparent scratches glass: the external lustre of the crystals is resinous: it is easily frangible, it occurs capillary, and in filaments. Specific gravity 5.—6.4.

E. LXX
CCXCV
(492

That of Cornwall consists of 69.76 oxide of lead, 26.4 arsenic acid, 1.58 muriatic acid. Gregor. Before the blow-pipe on charcoal it gives out arsenical vapours, and is reduced to globules of metallic lead.



M on M′	120 c.g
P on M or M′	90 ..
M on c	150 ..

The capillary variety is found at St. Prix in the department of the Saone in France.

In England, it occurs crystallized in a copper vein in granite, in Huel Unity near St. Day, Cornwall, mostly on quartz, sometimes on vitreous copper; in Huel Gorland on red oxide of copper; in North Downs mine, between Redruth and Truro, also in the Parish of Endellion, and more lately in the Beeralstone lead mines in Devonshire.

Reniform Arseniate of Lead. Bleiniere Karsten. It occurs in reniform masses of a brownish red colour, passing by exposure into ochre and straw yellow; the fracture is conchoidal with a resinous lustre; it is opaque, soft, and brittle. Specific gravity 3.9. It consists of oxide of lead 25, oxide of iron 14, silver 1.15, arsenic acid 25, silex 7, alumine 2, water 10. Bindheim.

It has only been found near Nertschinsk in Siberia.

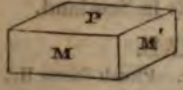
SULPHATE OF LEAD.

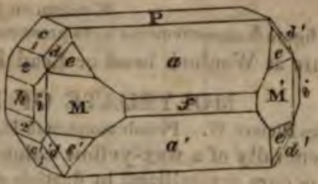
Blei Vitriol W. Plomb sulfaté H. Bt. Vitriol de Plomb natif Br.

It is white, and greyish-white, but is often externally of va-
CCLXXXV rious shades of grey and brown; it occurs crystallized, com-
(493) monly in the form of rhombic prisms with diedral terminations,
CXL (494) but the crystals, when the prism is short, assume the general
form of an octohedron: the structure is perfectly lamellar; it
XIX (495) admits of mechanical division parallel only to the planes of a
right rhombic prism of 103° 42′ and 76° 18′ by the reflective
XXX (496) goniometer, which therefore is the form of its primary crystal.
When reduced to thin laminæ it is often colourless and trans-
LXX (497) parent, with a splendent lustre; the cross fracture is conchoi-
dal with a resinous lustre; it is brittle, and yields to the nail;
CLXXI (498)

it is also found massive. Specific gravity 6.3. It consists of 70.5 oxide of lead, 25.75 sulphuric acid, 2.25 water. Klaproth. Before the blow-pipe it decrepitates, then melts, and is soon reduced to the metallic state.

Primary.





M on M'	103°.42'	M on *h*	128°.10'
P on M or M'	90. 00	—— c1	127. 56
—— *a*	140. 36	M on *i* or M' on *i*	160. 42
—— *e* or *e*	115. 40	*a* on *a'*	79. 30
—— *f*	90. 00	*a* or *a'* on *f*	129. 28
—— *h*	90. 00	c1 on c1'	104. 30
M on *e* or M' on *e'*	153. 20	—— c2	142.20
M or M' on *f*	141. 52		

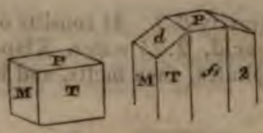
It occurs at Zellerfeld in the Hartz, with ores of iron, copper, and lead, and in the lead mines of Andalusia in Spain; and in Southampton lead mine in Massachusetts, North America, on sulphuret of lead, &c. and is accompanied by molybdate of lead, &c.

In Cornwall it occurred sparingly in a copper vein of Velenoweth mine near St. Ives, with sulphuret of lead, and yellow copper, &c. Abundantly in Parys mine in Anglesea, and in Scotland at Wanlockhead in Dumfries-shire, and the Lead hills in Lanarkshire, with galena and other ores of lead.

CUPREOUS SULPHATE OF LEAD.

Cupreous Sulphate of Lead. H. J. Brooke.

This newly observed mineral is of a deep blue colour, greatly resembling that of the brightest and more translucent varieties of the blue carbonate of copper. It scratches sulphate, but is scratched by carbonate of lead. Specific gravity 5.3—5.43; it occasionally includes particles of carbonate of lead and of cupreous sulphato-carbonate of lead. It cleaves parallel to the planes M & T of the following figures, very readily parallel to the former, but no cleavage has been observed in any other direction. The primary form may be considered as a right oblique-angled prism. Analysis of a few grains; sulphate of lead 74.4, oxide of copper 18, water 4.7. H. J. Brooke.



M on T	102°.45′
P on M	90 .00
—— T	90 .00
—— *f*1	90 .00
T on *f*1	161 .30
M on *d*	120 .30
M return on *f* 2	104 .50

The above figure & measurements were presented to me by H. J. Brooke, Esq.

It occurs at Wanlock head or Lead Hills in Scotland.

MOLYBDATE OF LEAD.

Gelbes Bleierz W. Plomb molybdaté H. Bt. Plomb Jaune Br.

It is generally of a wax-yellow colour, sometimes honey-yellow; it occurs crystallized in flattish and in acute octohedrons
.XXXI variously modified, in crystals nearly of the proportions of the
153 cube, and in tabular crystals: the structure is perfectly lamellar; it yields to mechanical division parallel to the planes of an
.XXX acute octohedron, with a square base, and also to the common
154 base of the two pyramids; the angle of one plane on the opposite plane over the summit being 49° 45′, and of a plane of the upper, on the adjacent plane of the lower pyramid 130°.15′; of any one plane on an adjacent plane of the same pyramid 99°.50, by the reflective goniometer, from planes produced by cleavage; the cross fracture is uneven, passing into small conchoidal, with a glistening resinous lustre; it is translucent, soft, and brittle. It rarely occurs massive. Specific gravity 5.09. It consists according to Hatchett, of 58.4 oxide of lead, 38 molybdic acid, and 2.08 oxide of iron. Before the blow-pipe it decrepitates; on charcoal it fuses into a dark-grey mass, in which globules of reduced lead are visible; with a little borax it forms a brownish globule, and with a larger quantity forms a blue or greenish-blue glass.

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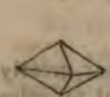
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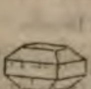
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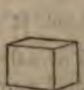
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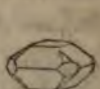
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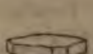
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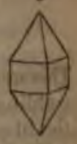
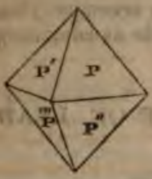
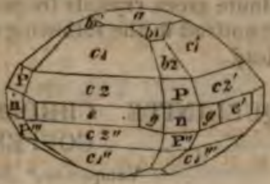


Fig. 1. An octohedron exhibiting only the planes of c1, of the following figure, and much flatter than the primary. Fig. 2, the same, of which the summits, and edges of the common base of the pyramids, are replaced by planes; these planes are increased and complete in fig. 3, producing a crystal nearly in the proportions of the cube. Fig. 4, an octohedron, of which all the solid angles, and the edges of the pyramids are replaced. Fig. 5, a tabular crystal arising from the deep replacement of the summits of a crystal similar to fig. 2, combined with the planes of fig. 4, which replace the lateral solid angles, Fig. 6, a quadrangular prism (fig. 3) terminated by acute pyramids.





P on P″, or P′ on P‴	131°.15′	*a* on *b* 1	172°. 7′
P on P″ or P″ on P‴	99 .50	—— *b* 2	143 .24
P or P′ on *a*	114 .15	c 1 on *c*′ 1	128 .23
P on *b* 2	150 .38	—— c 1″	76 . 0
a on *c* 1 or *c*′ 1	142 .10	*c* 2 on *c* 2′	99 .30

It occurs a Bleiberg in Carinthia, in limestone, with other ores of lead, and some of those of copper and zinc; it is found in the Tyrol, Austria, and Transylvania: in Massachusetts and Pennsylvania in N. America; in limestone in Mexico.

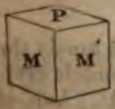
CHROMATE OF LEAD.

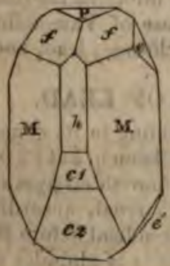
Roth bleierz W. Plomb chromaté rouge H. Bt. Plomb rouge Br.

It is of deep orange-red colour, when pulverized orange-yellow. Is occurs crystallized and massive; it cleaves parallel to all the planes of an oblique rhombic prism of about 93°.30′ & 86° 30′, the inclination of the summit being from one obtuse angle of the prism to the other; the cross fracture is uneven, passing into conchoidal, with a splendent lustre; it is sometimes translucent, rarely transparent, and is brittle. Specific gravity 6. It consists of oxide of lead 63.96, chromic acid 36.40. Thenard. When exposed to the blow-pipe, it crackles and melts into a greyish slag; with borax it is in part reduced to the metallic state, and gives a green colour to the flux.

8. IV
155

Primary.





M on M	93°.30′
P on M or M	99 .10
P on *e*	119 .10
—— *f*	133 . 0
—— *h*	102 . 5
M or M on *c* 2	133 .10
———— *f*	146 .25
———— *h*	136 .35
e on *f*	140 . 3
f on *f*	118 .58

It occurs in the gold mine of Beresof in Siberia, in a vein traversing gneiss and mica-slate: and near the same place in fissures in a sandstone.

The minute green crystals frequently accompanying this substance are noticed in the following article as consisting of phosphate of lead.

VAUQUELINITE. CHROMATE OF LEAD AND COPPER.

Vauqueline,* Berzelius.

This substance occurs in extremely minute crystals, aggregated irregularly, and constituting frequently a thin crust, occasionally with a tendency to the form of stalactites, which sometimes are hollow, sometimes include the chromate of lead of a dingy orange colour. The crystals are black, occasionally with a tinge of green, and when viewed by the assistance of a lens, are often splendent, but not sufficiently perfect for the use of the reflective goniometer; or they are without lustre, and brownish. Analysis by Berzelius, oxide of lead 60.87, oxide of copper 10.80, chromic acid 38.33. Before the blow-pipe on charcoal it intumesces slightly, fuses into a dark grey globule of metallic brilliancy, surrounded by small beads of reduced lead; but the globule suffers no change.

It occurs in Siberia on quartz accompanying the chromate of lead; the minute green crystals often occurring with the same substance, afford by the reflective goniometer the same measurements as those of the regular six-sided prism; my brother, R. Phillips, has found them to contain phosphoric acid, and they are assumed, both from that circumstance and their form, to be phosphate of lead.

The Vauquelinite is mentioned by Berzelius in his "Essay on the Blow-pipe;" the substance above described has at my solicitation been submitted to the action of the blow-pipe, by J. G. Children, Esq. who has obligingly informed me that "its characters correspond exactly with those of Vauquelin as given by Berzelius; it certainly contains chrome, lead, and copper."

TUNGSTATE OF LEAD.

CXLI
156

It is described as greatly resembling in its general aspect the brown phosphate of lead from Poullaouen, but its prismatic crystals are terminated by very acute four-sided pyramids, (Ann. of Philosophy, v. 12.) Alone on charcoal, according to Berzelius, it fuses and gives off a vapour of lead before the blow-pipe, and with soda yields a large quantity of globules of lead.

It occurs at Zinnwald in Bohemia.

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* Vauqueline, in honor of the celebrated French chemist of that name.

ZINC.

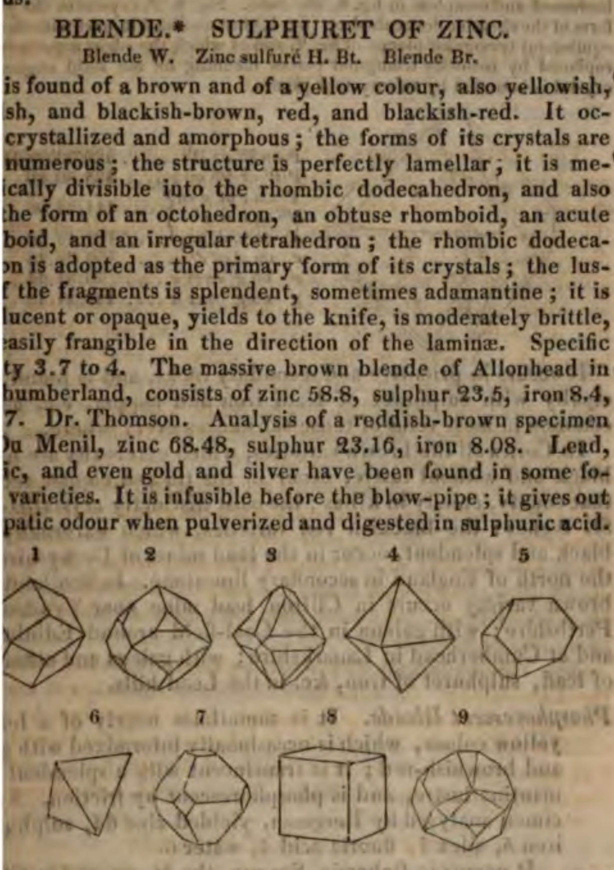
does not occur in the metallic state; its ores are not nu-
us.

BLENDE.* SULPHURET OF ZINC.

Blende W. Zinc sulfuré H. Bt. Blende Br.

is found of a brown and of a yellow colour, also yellowish, CCCXCVI
sh, and blackish-brown, red, and blackish-red. It oc- (49
crystallized and amorphous; the forms of its crystals are
numerous; the structure is perfectly lamellar; it is me- CCCXCVII
ically divisible into the rhombic dodecahedron, and also (500
he form of an octohedron, an obtuse rhomboid, an acute
boid, and an irregular tetrahedron; the rhombic dodeca-
on is adopted as the primary form of its crystals; the lus-
the fragments is splendent, sometimes adamantine; it is
lucent or opaque, yields to the knife, is moderately brittle,
asily frangible in the direction of the laminæ. Specific
ty 3.7 to 4. The massive brown blende of Allonhead in CCCXCVII
humberland, consists of zinc 58.8, sulphur 23.5, iron 8.4, (501
7. Dr. Thomson. Analysis of a reddish-brown specimen LXXIV
u Menil, zinc 68.48, sulphur 23.16, iron 8.08. Lead, (502
ic, and even gold and silver have been found in some fo-
varieties. It is infusible before the blow-pipe; it gives out LXXV
patic odour when pulverized and digested in sulphuric acid. (503)

CXII (504



1. The primary; a rhombic dodecahedron. Fig. 2. The same, of
eight of the solid angles are replaced by as many triangular planes:
, in Fig. 3, are increased greatly, forming the passage of the rhombic
hedron into the regular octohedron fig. 4. Fig. 5 is an octohedron,
has received an increase of crystalline laminæ progressively diminish-
size, on two opposite faces (right and left) of the upper pyramid, and
other two opposite faces on the lower pyramid; this crystal forms the

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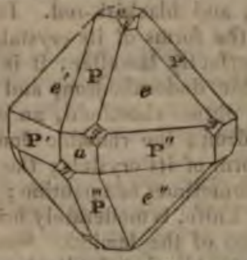
rom the German, signifying glistening; in allusion to its shining
ls.

passage of the octohedron into the tetrahedron, fig. 6; in which the triangular planes of fig. 5, have received a still further increase of crystalline laminæ progressively diminishing to a point. Fig. 7, a regular octohedron, of which the six solid angles are replaced by quadrangular planes, which are increased and complete in fig. 8, the cube. Fig. 9. A crystal in the general form of the rhombic dodecahedron (fig. 1,) but modified in part with the small equilateral triangular planes of fig. 2, and of which the edges are alternately replaced by isosceles triangular planes inclining on the solid angles; the crystal is bounded by twenty-four planes.



P on P′ or P″	120°00′00″H
P P′ or P″ on a	135.00.00 ..
P on e or e′ or P″ on e or e″	144.44.08 ..
a on e, e′, or e″	125.15.52 ..
e on e′ or e″	109.28.16 ..
e′ on e″ over a	70.31.44 ..
g on g over a	129.31.18 ..

It occurs in primitive and secondary rocks, and is found principally with sulphuret of lead, iron and copper, &c. and is common in most veins of those substances every where.

In Cornwall the brown varieties, which externally are nearly black and without lustre, occur in the tin and copper veins of that county, chiefly in killas; the most distinctly crystallized in St. Agnes: the blackish red varieties, which externally are black and splendent, occur in the lead mines of Derbyshire and the north of England in secondary limestone. In Scotland, the brown variety occurs in Clifton lead mine near Tyndrum in Perthshire; with galena in the Coal-field around Edinburgh, and at Cumberhead in Lanarkshire; with galena and other ores of lead, sulphuret of iron, &c. in the Lead hills.

Phosphorescent Blende. It is sometimes nearly of a lemon-yellow colour, which is occasionally intermixed with green and brownish-red; it is translucent with a splendent adamantine lustre, and is phosphorescent by friction. A specimen analysed by Bergman, yielded zinc 64, sulphur 20, iron 5, silex 1, fluoric acid 4, water 6.

It occurs in Bohemia, Saxony, the Hartz, and in Clifton mine near Tyndrum in Perthshire, and in Flintshire.

Fibrous Blende. It is of a reddish-brown colour, and occurs reniform and massive; the structure is divergingly fibrous in one direction with a resinous lustre, concentric lamellar in the other; it is opaque, or feebly translucent on the edges.

It occurs with a sulphuret of lead and iron at Geroldseck in the Brisgau, and at Rabel in Carinthia.

Mamillated Blende? It is brown externally, or blackish-brown, internally it varies from yellowish-white to hair-brown; it occurs in mamillated and botryoidal masses, of which the structure is concentric lamellar; the fracture in the other direction is flat conchoidal; it is opaque, or translucent only on the edges; it is hard, and yields to the knife with difficulty. It consists, according to professor Kidd, of 66 oxide of zinc, and 33 of sulphur. This mineral appears, by this analysis, to be a somewhat singular compound; in common blende, the zinc is not in the state of an oxide. CCXLIX (50

It occurs in Huel Unity copper mine in Cornwall, either in small masses or investing copper pyrites, and is itself sometimes coated by carbonate of iron.

Cadmiferous Blende. The splendent fibrous blende of Przibram possesses a lustre very nearly metallic, especially after fresh fracture; its structure is radiated, the fibres are shining, and of a brown colour. It occurs imbedded in common massive blende and associated with cubic crystals of sulphuret of lead. Specific gravity 4.000. The presence of cadmium in this mineral was first discovered by Stromeyer. It has since been found by Dr. Clarke in the radiated siliciferous oxides of zinc of Freyberg and Derbyshire.

Dr. Clarke thus describes the mode of detecting the presence of cadmium in the carbonates and silicates of zinc. Place about the 10th of a grain of either of them in a state of powder, on a slip of platinum foil. By the direction of the blue flame of a common candle on it, the oxide of cadmium, if present, will be reduced and volatilized, and a protoxide will be deposited on the surface of the platinum of a peculiar reddish-brown colour.

RED OXIDE OF ZINC.

Red oxide of Zinc, Bruce.

It is of various shades of red, sometimes ruby or blood-red; occurs massive, disseminated, and micaceous; the structure is E.LXXX /5 mellar; it yields to mechanical division parallel to all the lanes of a regular six-sided prism, each lateral plane on the adining one being 120°, and the terminal on the lateral plane 0°, by the reflective goniometer; the principal cleavage is arallel to the terminal plane of the prism; it is translucent, id when reduced to thin laminæ nearly transparent, with a ining lustre; but by long exposure it becomes dull and cover-l by a pearly crust. It is brittle, and is easily scratched by the knife. Specific gravity 6.2. It consists of zinc 76, oxygen 16, oxides of manganese and iron 8, Bruce; but according to Berthier, it consists of oxide of zinc 88, red oxide of manganese 12. It is supposed to be coloured by the latter substance. It is infusible before the blow-pipe without addition; but with sub-carbonate of soda it melts into a transparent yellow bead: when pounded, and exposed to heat with potash, it fuses into an emerald-green mass.

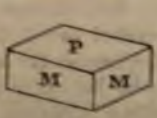
It is found only in New Jersey N. America, in the Franklin, Stirling, and Rutgers iron mines, and near Sparta. It is sometimes imbedded in calcareous spar, and accompanies magnetic iron, and the Franklinite. The micaceous variety is found in Franklin mine, imbedded in a whitish oxide of zinc.

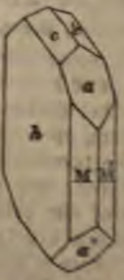
SILICEOUS OXIDE OF ZINC. ELECTRIC CALAMINE.

Electrical Calamine, Smithson. Zinc oxydé H. Zinc Calamine Bt.

CCXLVIII It is of a greyish, bluish, and yellowish-white, occasionally
(506) it possesses a tinge of green, and sometimes is brownish or blackish
externally, and irridescent. It occurs crystallized, stalactitic,
VI (507) mamillated, botryoidal, and massive. The crystalline forms
are numerous : the primary form is that of a right rhombic prism
CCLXI of about 102° 30′ and 77° 30′ by the reflective goniometer; the
(505) crystals are not often solitary, but are mostly disposed in radiated
groupes; it varies from transparent to opaque; it yields to
CCLXII the knife, but is much harder than the carbonate of zinc. Specific
509 gravity 3.4. That of Wanlockhead consists of oxide of
zinc 66, silex 33, Klaproth. A foreign specimen yielded 68.3
oxide of zinc, 25 silex, and 4.4 water, Smithson. When gently
heated it is strongly electric; some varieties become so by friction.
Before the blow-pipe it is infusible, but loses about 12
per cent. by ignition.

Primary.





M on M′	102°30′
M or M′ on a	132.35
M on h	128.40
a on c or c′	115.00
c on c′	126.36

It occurs in primitive and secondary rocks.

It is found at Rezbania in Hungary, at Bleiberg in Carinthia, ınd at Freyberg in the Brisgau.

In Scotland, it occurs in the lead mines of Wanlockhead; in Wales, in Flintshire: in England, with blende, sulphuret of opper, and galena, in the mines of Earl Ferrers in Leicestershire; that of Cumberland cavern near Matlock in Derbyshire ontains cadmium, according to the late Dr. Clarke.

CARBONATE OF ZINC. CALAMINE.*

Galmei, Karsten. Zinc carbonaté H.

It is found crystallized, compact, pseudomorphous, earthy, nd cupriferous.

rystallized Calamine. It is commonly greyish or yellowish, but also occurs of various shades of green and brown; it is found in obtuse and acute rhomboids and in long quadrilateral tables which sometimes are modified: the structure is perfectly lamellar, yielding to cleavage parallel to all the planes of an obtuse rhomboid of about 106° 30′ & 73° 30′ by the reflective goniometer; the external lustre of the crystals is between vitreous and resinous; it is more or less transparent, and yields easily to the knife. Specific gravity 4.3. That of Derbyshire consists of oxide of zinc 65.2, carbonic acid 34.8. Smithson. Dr. Clarke, however, has found cadmium to be a constituent of the diverging varieties of Freyberg, and also of the radiating variety of Derbyshire in the proportion of about 6-10ths of a grain per cent. It is infusible; but loses about 34 per cent. by ignition: it dissolves with effervescence in muriatic acid.

CCCCLX;
(5
CCCCLX;
(5

ompact Calamine. It is greyish, yellowish, greenish, sometimes brownish or brown owing to an intermixture of iron; it occurs stalactitic, reniform, mamillated, cellular, and amorphous; it possesses a glistening lustre; it is sometimes imperfectly fibrous; the fracture splintery and uneven; it is occasionally translucent on the edges. It consists of 64.8 oxide of zinc, 35.2 carbonic acid. Smithson.

CCII (57

seudomorphous Calamine. It commonly occurs in the form of the crystals of carbonate of lime, familiarly termed Dog-tooth-spar, on which it is supposed to have been deposited; but which have been decomposed, so that the pseudomorphous crystals of calamine are left hollow; they are dull externally.

CCI (513

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* From the Latin, Calamus, a reed; when in fusion, it adheres to the ase of the furnace, in the form of reeds.

Earthy Calamine. It is white, or greyish or yellowish-white, and is dull, opaque, yields to the nail and adheres to the tongue; it occurs massive, disseminated, and investing. Specific gravity 3.58. It consists of oxide of zinc 71.4, carbonic acid 13.5, water 15.1. Smithson.

CCXLVII (514) *Cupriferous Calamine.* It occurs in extremely thin crystalline lamellæ divergingly aggregated, with a sattiny lustre. Its colour is supposed to be owing to carbonate of copper.

Calamine is found in beds and veins in secondary limestone; often in lead veins, and sometimes in conglomerate rocks.

It occurs in several countries of the European continent, and in Siberia.

In England it is very abundant; as in the Mendip hills at Shipham, near Cross, Somersetshire; at Holywell in Flintshire, where it occurs in obtuse rhomboids; near Castleton in Derbyshire; it also occurs with galena in veins in the mountain limestone of Bristol; and in a cross vein near Nent-head in Durham; the pseudomorphous variety occurs at Holywell in Flintshire, and near Bristol: the cupriferous variety in Rutland Cave mine near Matlock, Derbyshire.

SULPHATE OF ZINC. WHITE VITRIOL.

Zinc sulphaté H.

CXLIX (515) It is greyish, yellowish, reddish, or greenish-white; and occurs massive, stalactitic, botryoidal, reniform, and investing; also it is said crystallized in rectangular prisms, terminated by quadrangular pyramids, and in acicular crystals. The structure of the massive is fibrous and radiated; it is shining, translucent, soft, and brittle. Specific gravity 2. It has a nauseous metallic taste. It consists of oxide of zinc 27.5, sulphuric acid 22, oxide of manganese 0.5, water 50. Before the blow-pipe it is fusible with ebullition, giving off large quantities of sulphurous acid, and leaving a grey scoria. It dissolves in boiling water.

It occurs principally where blende is found, and is supposed to arise from its decomposition.

It is found in the Hartz, in Austria, Hungary, and Sweden.

In England at Holywell in Flintshire, and is said also to occur in Cornwall.

QUICKSILVER. MERCURY.

It is found in the native state: its ores are not very numerous.

NATIVE QUICKSILVER.

Gediegen Quicksilber W. Mercure natif H. Bt.

It is of a silver-white colour, with a splendent metallic lustre; it occurs disseminated in fluid globules, which may often be increased in number by subjecting the gangue to the action of heat. Specific gravity 13.6. According to Klaproth it contains no intermixture of another metal. It volatilizes entirely before the blow-pipe at less than a red heat.

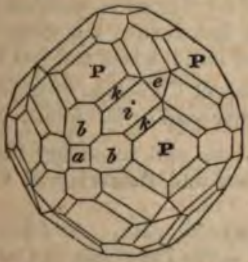
It is found in small quantity in primitive rocks, but is more common in some countries in those of the Coal formation.

It occurs in most of the mines producing the ores of Quicksilver.

NATIVE AMALGAM.

Naturlisches Amalgam W. Mercure Argental H. Bt. Silver Amalgam A.

It is of a silver-white, or greyish; it occurs in a semi-fluid E. I. 158 state; it is also found massive, and crystallized in several forms, of which the rhombic dodecahedron may be adopted as the primary, but no cleavage has been observed; it has a flat conchoidal fracture, is soft, cracks when cut, and is very heavy. It consists of 64 of quicksilver, and 36 of silver. Klaproth. Before the blow-pipe the mercury is volatilized, and a bead of pure silver remains. It whitens the surface of copper when rubbed warm upon it.



P or P on P ...	120° 2′
P on *a*	135.00
—— *b*	154.00
—— *i*	150.00
—— *k*	160.40
a on *b*	161. 2
i on *k*	169. 5

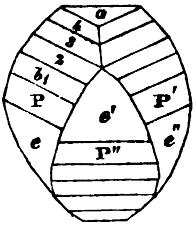
It is found at Rosenau in Hungary, the Palatinate, Deux ponts, Salzburg, Sweden, and is frequently accompanied by native quicksilver and cinnabar.

CINNABAR.* SULPHURET OF MERCURY.

Zinnober W. Mercure sulfuré H. Bt. Cinnabre Br.

It varies in colour from carmine through cochineal-red, to lead-grey; it occurs massive and crystallized, according to Haüy, in the form of an acute rhomboid of 71° 48′ & 108° 12′, which is considered to be its primary form; but the crystals are mostly modified by secondary planes. It is translucent or transparent. The structure is lamellar, in the massive sometimes curved, with a shining lustre; it is also found of a granular texture, and glimmering, or dull and opaque; fibrous with a glimmering lustre: also pulverulent. It gives a bright scarlet streak. The lamellar variety consists of 84.5 quicksilver, 14.75 sulphur, Klaproth. Before the blow-pipe it melts, and is volatilized with a blue flame and sulphureous odour.

VIII
/59



P on	P′....	71°48′
P on	b2 ...	157.20
——	b3 ...	152. 8′
——	e	159.18
a on	b1 ...	127. 5
——	b2 ...	133.22
——	b3 ...	138.34
——	b4 ...	146.31
e on	b1 ...	142.55
——	b3 ...	131.26

The preceding figure and measurements are given on the authority of Haüy.

Hepatic Cinnabar. It is of a very dark red, sometimes nearly iron-grey: it occurs both compact and slaty: the latter often encloses native quicksilver: the fracture of the compact is fine grained, with a glimmering lustre; it is opaque, easily frangible, and sectile. Specific gravity 7.1. A specimen from Idria, analysed by Klaproth, yielded mercury 81.8, sulphur 13.7, with less than 1 per cent. each of silex, alumine, and oxide of iron: water and loss 7.30.

Bituminous Cinnabar. It consists of Cinnabar, or hepatic Cinnabar, intermixed with coarse coal or bituminous shale.

It is found sparingly in clay-slate and secondary limestone; most abundantly in the sandstone and slate-clay of Coal formations.

In Rosenau in Hungary in clay-slate, &c. At Idria in Carniola, at Almaden in Spain, and in the Palatinate in Coal formations; it occurs in several other European countries: in Siberia; in New Spain in slate-clay and sandstone.

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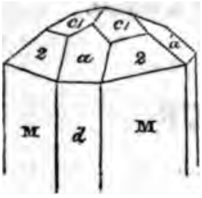
[*] From the Greek, signifying a red coloured grain.

XVII

50 **HORN QUICKSILVER. MURIATE OF MERCURY.**

Quicksilber Hornerz W. Mercure muriaté H.

It is greyish-white, grey, yellowish and greenish-grey: it occurs crystallized in quadrangular prisms terminated by pyramids; also in tubercular crusts, rarely massive; it is translucent, with a lustre between adamantine and vitreous, and is sectile. It consists of 76 oxide of mercury, 16.4 muriatic acid, 7.6 sulphuric acid. Klaproth. Before the blow-pipe on charcoal it is totally volatilizable; is soluble in water, and the solution gives an orange precipitate with lime-water.



M or M	90°00′
M or M on *c* 1 or *c* 1	129.30?
— — — — *c* 2 or *c* 2	158.00
— — — — *d*	135.00
a on *d*	119.30?

The preceding figure and measurements are given on the authority of H. J. Brooke, Esq.

It occurs with most of the preceding varieties in Bohemia, in Deux-ponts, the Palatinate, and at Almaden in Spain.

COMBUSTIBLE MINERALS;

Including those of which the base is sulphur or carbon. It includes substances of the most opposite external characters; both the hardest, and the softest in nature.

SULPHUR.

It is of two kinds; native and volcanic.

NATIVE SULPHUR.

Natürlischer Schwefel W. Soufre H.

XVII It is of various shades of yellow, from pale to deep orange;
161 and sometimes has a tinge of green. It occurs massive, disseminated, investing other minerals, and crystallized in the form
(516) of an acute octohedron either perfect or variously modified: the primary is an octohedron with equal and similar scalene triangular planes, and of which the common base of the two pyra-
(517) mids is rhombic: the fracture is conchoidal, uneven in the impure varieties; the lustre is shining and resinous: it is very brittle. Specific gravity about 2. It burns readily with a lambent blue flame and suffocating odour, and fuses into a brown liquid. It acquires the resinous electricity by friction.

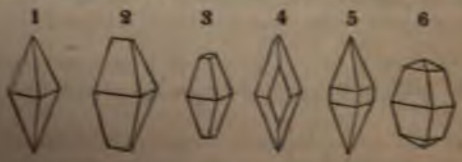
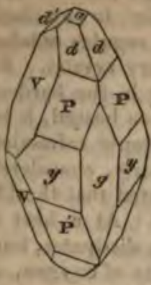


Fig. 1. The primary octohedron. Fig. 2, the same elongated. Fig. 3, the same, of which the summits are replaced. Fig. 4. In this, two opposite solid angles of the octohedro[illegible]laced by rhombic planes. Fig. 5. In this,

the edges of the common base of the two pyramids is deeply replaced by quadrangular planes. In fig. 6, the summits of the octohedron are replaced each by four triangular planes, forming a low pyramid on each.



P on P	106°30′
P on P over v	85. 5
P on P′	143.25

It is found in veins and beds in primitive and secondary rocks. In Suabia, in veins traversing granite; near Schemnitz in Hungary in mica-slate, and in the same rock in Quito in Peru: near Gibraltar in Spain in swinestone; at Bex in Switzerland in calcareous spar and the gypsum of the salt deposit; in the same rock in many other countries of the European continent: it occurs most abundantly in this kind of deposit, generally in beds, or disseminated in large masses.

VOLCANIC SULPHUR.

It is of various shades of yellow and reddish-yellow. It occurs massive, investing, cellular, and in small crystals of the same form as those of native sulphur. It agrees pretty much in character with native sulphur.

It occurs in the fissures of lava near the craters of volcanoes. It is met with in Italy, Iceland, in Guadaloupe and Nevis in a volcanic mountain yet in activity. The volcanoes of the Cordilleras in Quito, yield it in great abundance and very pure.

But perhaps the most remarkable deposit of volcanic sulphur is that of Solfatara near Naples, in a kind of sunken plain surrounded by rocks, which is regarded as the crater of an ancient volcano; and from it, ever since the age of Pliny, has been obtained a considerable proportion of the sulphur used in Europe.

DIAMOND.*

Diamant W. H.

& CXVIII
CXIX

Diamonds are either colourless, or of a yellowish, bluish, yellowish green, clove brown, black brown, prussian blue, or rose red colour. They are always found in detached crystals, and the varieties of form in which they occur are numerous: the faces are often convex, and they are extremely subject to the compound crystallization, termed the macle. The structure is perfectly lamellar, yielding readily to mechanical division parallel to all the planes of the regular octohedron, which therefore is the form of the primary crystal. It varies from transparent to nearly opaque. It is the hardest of all substances. Specific gravity 3.5. When heated, it becomes phosphorescent. It possesses only a simple refraction, which has been attributed greatly to its density, considered as a stone. Newton, in remarking this, suspected that the Diamond ought to be placed among combustibles. At a heat less than the melting point of silver, it gradually dissipates, burns, and combines with nearly the same quantity of oxygen, and forms the same quantity of carbonic acid, as charcoal: whence it appears to consist of pure carbon. Dr. Clarke exposed a diamond of an amber colour to the flame of a gas blow-pipe: it became colourless and transparent; by continuing the heat it became white and opaque, and was volatilized.

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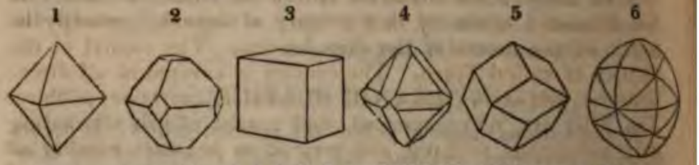
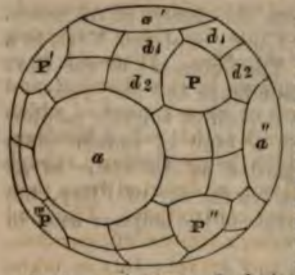
* Perhaps from Adamus (Pliny) signifying—unconquerable.



For transitions of figs. 1, 2, 3, 4, 5, see Red Oxide of Copper, p 306.



The crystal represented by the annexed figure is in the superb collection of Diamonds in the possession of Wilson Lowry, Esq. who obligingly permitted me to examine the whole series. This was selected as exhibiting with more than usual beauty and precision, the planes of the primary octohedron P, P′, P″, and P‴, and those of the cube *a*, *a*′, and *a*″, which are generally flat and brilliant. The numerous faces *d* 1 and *d* 2 are uniformly convex; each of these faces is, in reality, a series of planes, as is manifest on other crystals, but in no instance sufficiently perfect for the use of the reflective goniometer. In the last of the small preceding figures, these faces are shewn to the exclusion of the planes of the octohedron and cube. The true angles of these solids are added, and of the meeting of their planes;

P on P′ or P″	109°28′ 16″
P on *a*, *a*′, or *a*″........	125.15.52
a on *a*′ or *a*″	90.00.00

In India, the Diamond mines extend through a long tract of country, from Bengal to Cape Comorin, at the foot of a chain of mountains 50 miles in length : the chief of them are now between Golconda and Masulipatam. Diamonds are also procured from the Isle of Borneo and from Brazil ; where, as well as in India, they are found in beds of ferruginous sand or gravel.

Fifty years ago there were more than 20 places in the kingdom of Golconda in which Diamonds of different sizes were found. At that period, 50 workings were also wrought in the kingdom of Visapour. These mines furnished more diamonds than the others ; but being smaller, the workings were abandoned. The Diamonds of Pastael, 20 miles from Golconda at the foot of the Gate mountains, are the most in request. The mines are situated at the conflux of two rivers ; they have produced the most noted Diamonds, and amongst them that which has obtained the name of the Pitt or Regent Diamond, the finest of the crown jewels of France, weighing 136 carats, or nearly an ounce, and which was purchased for 2,500,000 livres ; about £100,000 sterling.

From Mawe's Travels in the Interior of Brazil, we find that the Diamond mines of that country are situated nearly due north of the mouth of the Rio Janeiro. The capital of the district is called Tjuco. The country is covered in all directions by grit-stone rocks, full of rounded quartzose pebbles. The hills are very numerous, and consist of grit alternating with micaceous schistus, and present an immense number of blocks composed of grit-stone imbedding rounded masses of quartz, giving to the whole the appearance of a pudding-stone. The general level of the country must be considerably elevated ; it is very full of streams, which fall into the rivers traversing the lower country in almost every direction. Diamonds have been largely obtained in various places in this district, and always from the beds of the streams or rivers ; most of which have yielded them. The principal work is that called Mandanga on the river Jigitonhonha : which being shallow, though broad, its waters are either dammed out, or diverted from their course, or pumped out by a particular contrivance. The mud of the river is then removed, discovering a stratum of *cascalhão*, which consists of rounded pebbles and gravel ; this is taken up, and the Diamonds are washed out of it. Diamonds are by no means peculiar to the beds of rivers or ravines ; they have been found in cavities and water-courses, on the summits of the most lofty mountains of the district.

One of the largest known Diamonds was in the possession of the late Empress of Russia ; it was of the size of a pigeon's egg and weighed 193 carats or nearly one ounce and one-third of an ounce.

The largest Diamond hitherto found, is in the possession of the Rajah of Mattan, in the island of Borneo, in which island it was found about a century ago. It is shaped like an egg, with an indented hollow near the smaller end. It is said to be of the finest water. It weighs 367 carats. Now as 156 carats are equal to 1 oz. Troy, it is obvious that this Diamond weighs 2 oz. 169.87 gr. Troy. Many years ago the governor of Batavia tried to purchase this Diamond. He sent a Mr. Stewart to the Rajah, who offered 150,000 dollars, two large war brigs with their guns and ammunition, together with a certain number of great guns, and a quantity of powder and shot. The Rajah, however, refused to deprive his family of so valuable an hereditary possession, to which the Malays attach the miraculous power of curing all kinds of diseases, by means of the water in which it is dipped, and with which they imagine that the fortune of the family is connected.

MINERAL CARBON. MINERAL CHARCOAL.

Mineralische Holzkohle W.

Mineral Carbon is black or of a greyish-black colour, and is LIX destitute of bitumen; it consists of charcoal, with various pro- (518) portions of earth and iron.

It has a glimmering, silky lustre, and a fibrous appearance, discovering a wood-like texture. It is somewhat heavier than L (519) common charcoal, and is easily reduced to ashes before the blowpipe, without either flame or smoke.

It occurs in thin layers in brown coal, slate coal, slaty glance coal, and pitch coal; but in quantities too small to be made separate use of.

PLUMBAGO.* GRAPHITE. BLACK LEAD.

Graphit W. H.

It is of an iron or steel-grey colour. It occurs of a lamellar LXVII texture in mass, in kidney-shaped lumps, or disseminated in (520) rocks: also, though rarely, crystallized in the form of the regu- XXVII lar six-sided prism, of which the summits are striated parallel to their edges. (521) It has a glistening metallic lustre, its fracture is granular and uneven; it is unctuous to the touch, soft, and not

LXIX

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522) * Plumbago, from its drawing like lead (its streak being of the same colour). Graphite; from the Greek, to draw; in allusion to its use.

very brittle. Its streak is lead-coloured. Its specific gravity somewhat exceeds 2. It consists of 90.9 of carbon, and 9.1 of iron. Berthollet. When heated it burns by a full and long continued heat, without flame or smoke, leaving behind a portion of red oxide of iron.

It belongs chiefly to primitive rocks.

It occurs in granite in Bavaria; in gneiss in Piedmont; in mica-slate in Calabria; in serpentine in Andalusia; in syenite in New York, in six-sided tables of a lamellar structure; with pargasite in Finland, &c. It also occurs in France in granular limestone, in Bohemia, Austria, &c. &c.

The purest and most esteemed Plumbago is found in Borrodale in Cumberland, where it occurs in a considerable mountain of schistose rocks, traversed by veins of quartz; some account of the mine may be found in Parkes's 'Chemical Essays.' A variety inferior in lustre to that of Borrodale has lately been found imbedded in mica-slate at Strathferran near Beauly, Aberdeenshire. It has also been found passing into a kind of coal of a columnar form at Crumnock in Ayrshire. It occurs near Kilkenny well in Ireland.

ANTHRACITE.* BLIND COAL.

Glanzkohle W. Anthracite H. Bt. Blende charbonneuse Br.
Glance Coal J.

Of this substance there are three varieties; the massive, slaty, and columnar.

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Massive Anthracite. Conchoidal Glance Coal J. It is of an iron-black colour, often superficially tarnished, and occasionally with a splendent metallic lustre; the fracture is conchoidal with a shining metallic lustre: it is light and brittle. It burns without flame or odour, leaving a whitish ash.

It occurs at Meissner in Hesse. In England, at Walsall in Staffordshire.

Slaty Anthracite. Slaty glance Coal J. It is of a black or brownish-black colour. The structure is imperfectly slaty in one direction, with a somewhat metallic lustre; the cross fracture is flattish conchoidal. It is easily frangible, somewhat sectile, and brittle. Specific gravity 1.4—1.8. According to Dolomieu, when reduced to powder, and heated in a crucible, it does not give out any sulphureous or bituminous odour, and on distillation, affords neither sulphur nor bitumen. By exposure to considerable heat, it burns without flame, and at length is consumed, leaving an ash. It consists of carbon 72.05, silex 13.19, alumine 3.29, oxide of iron 3.47.

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* Anthracite, from the Greek; consisting of carbon.

It occurs in primitive and secondary rocks. In Norway with native silver in veins traversing mica-slate; in the same rock in Switzerland and Savoy, also in clay-slate; in Spain in gneiss; in greywacké in Dauphiné.

In Scotland, in Calton hill, Edinburgh, in veins of calcareous spar traversing trap rocks, and also in several other places in Scotland, where it is termed *Blind Coal.*

CCX (523) In England it is found in the coal-formation near Walsal in Staffordshire (*Stone Coal*). In Wales, in the southern parts of Brecknockshire, Carmarthenshire, and Pembrokeshire (*Welch Culm*). In the same situation near Cumnock and Kilmarnock in Ayrshire, Scotland, and at Kilkenny in Ireland (*Kilkenny Coal.*)

Columnar Anthracite. Columnar glance-coal J. It occurs in the form of small short prismatic concretions, either straight or curved: it is of an iron-black colour, with a shining metallic lustre, and occasionally is tarnished externally. It is opaque, soft, light, and brittle. It burns without flame or smoke.

It appears to occur chiefly in the neighbourhood of secondary trap rocks.

It is found at Meissner in Hesse, with brown-coal, bituminous wood, &c. and basalt.

MINERAL OIL.

Under this term are comprehended two substances, Naptha and Petroleum; both of which are liquid, highly inflammable, and lighter than water.

1. NAPTHA.*

Bitume liquide blanchâtre H. Le Napthe Br. Bitume napthe Bt.

It is nearly colourless, sometimes yellowish, and transparent; it burns with a blue flame, much smoke, gives out a penetrating odour, and leaves no residuum. It appears to be the only fluid in which oxygen does not exist in considerable proportion: advantage has been taken of this circumstance by Sir H. Davy, who employed it, for that reason, in preserving the new metals discovered by him.

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* From the Greek; signifying—to take fire.

By the elaborate experiments and analysis of Saussure, it apears that naptha is composed of carbon 87.21, and hydrogen 2.79. It may therefore be termed a carburetted hydrogen.

A pure colourless specimen from Persia, having the taste and mell of naptha made from coal in this country, and of the speific gravity of .753, has been examined by Dr. Thomson: he oncludes it to be a compound of 9.75 carbon, 1.75 hydrogen; ut there was a deficiency of 3 per cent. which he supposes to e nitrogen.

It was not very volatile; it boiled at 320°.

The most copious springs of naptha are on the coast of the aspian Sea in the peninsula of Apcheron; the surrounding ountry is calcareous, and the soil which affords the naptha is andy and marly. It perpetually gives out vapour of a penerating odour and very inflammable: it is said that the people f the country dress their food by means of it, for which purose they pass it through earthen pipes. By distillation it ields naptha pure for medicine. The Persians employ the reiduum to burn in their lamps instead of oil. A considerable evenue is derived from it by the Chief of the country.

Naptha is also found in Calabria; on Mount Zibio near Molena: in Sicily, and in America, &c.; but it is supposed that ravellers have sometimes mistaken petroleum for naptha.

In 1802, near the village of Amiano, in the State of Parma, a pring of naptha of a topaz-yellow colour, was discovered, which eadily burns without leaving any residue; it rises in sufficient uantity to light up the city of Genoa, for which purpose it is mployed.

2. PETROLEUM.

Bitume liquide noirâtre H. Petrol Br. Bitume Petrole Bt.

Petroleum, at the usual temperature, is rather thicker than ommon tar, has a strong disagreeable bituminous odour, and is f a blackish or reddish-brown colour. It is very combustible, CCCCIX
iving our during combustion a very thick black smoke, and /524
eaving very little residue in the form of a black coal.

It is found in many countries, principally in those producing oal. At several places in France. In England, at Ormskirk n Lancashire, and at Coal Port, near Coalbrookdale. In Scotand, at St. Catherine's well near Edinburgh, and in the Isle of Pomona, one of the Hebrides. It occurs also in Bavaria, witzerland, and in Italy near Parma. Near the latter place, he petroleum gives out so powerful an odour, that the work-

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* From two Greek words, signifying rock (mineral) oil.

men cannot long endure it at the bottom of the petroleum wells, without danger of fainting. It is found in many other parts of Europe and in America.

It is most plentifully found in Asia: round the town of Rainanghong in the Birman empire, there are 520 wells in full activity, into which petroleum flows from over coal. No water ever penetrates into these wells. The quantity of petroleum annually produced by them amounts to more than 400,000 hogsheads. To the inhabitants, its uses are important; from Moussoul to Bagdad it is used instead of oil for lamps; mixed with earth or ashes, it serves for fuel.

When naptha is exposed to the air and light, it becomes brown, thickens, and seems to pass into petroleum: and when petroleum is distilled, an oil is obtained from it similar to naptha. When petroleum is exposed to the air, it thickens and passes into a kind of bitumen. Considerable alliance is thus proved to exist between mineral oil and bitumen.

BITUMEN. MINERAL PITCH.

Of bitumen there are three varieties.

1. EARTHY BITUMEN. (MALTHA?)

Erdigès Erdpech W. Bitume glutineux H. La poix minerale terreuse Br. Bitume Malthe Bt. Earthy mineral pitch J. Cohesive mineral pitch, A.

It is of a blackish-brown colour, and is dull; the fracture is earthy and uneven; it is soft enough to take an impression of the nail; it is sectile, and possesses a strong bituminous odour. It burns with a clear brisk flame, emits an agreeable bituminous odour, and deposits much soot. It appears to consist of inflammable matter, mingled with a considerable proportion of earthy substances.

C4X1
(525)

It is found in France, at a place called Puy de la Pège, where it renders the soil so viscous, that it adheres strongly to the foot of the traveller. It is also found in a mountain in Persia, between Schiraz and Bender-congo, where it is called baumemomie. It is collected with care, and sent to the king of Persia as being efficacious in the cure of wounds. It is occasionally used as a pitch, and in certain varnishes to preserve iron from rust. It also occurs in the Hartz.

It is said to have been found in Carharack mine in Cornwall?

2. ELASTIC BITUMEN.

Elastiches Erdpech W. Bitume elastique H. La poix minerale elastique H. Bitume elastique Br. Elastic mineral pitch J. A. DXXI (52

Elastic bitumen is of various shades of brown; it is soft, yields easily to pressure, is flexible, elastic, possesses a strongly bituminous odour, and is about the weight of water. It burns readily with a large flame and much smoke, but melts by a CXXXV gentle heat, and is thereby converted into a substance resembling (52 petroleum, or maltha, or asphalt, according to its previous consistence. CXXXVII

It takes up the traces of a pencil in the same manner as the (52 caoutchouc or India rubber, whence it has obtained the name CXXXI of *Mineral Caoutchouc.*

Hitherto it has only been found in the Odin mine, near (52 Castleton in Derbyshire, in a secondary limestone, accompanied CXL (5 by calcareous spar, fluor, blende, galena, pyrites, and asphalt. Elastic bitumen consists chiefly of bituminous oil, hydrogen gas, and charcoal; very small proportions of other substances have been detected by analysis.

3. COMPACT BITUMEN. ASPHALT.

Schlackiges Erdpech W. Bitume solide H. La poix minerale scoriacée Br. Bitume asphalte Bt. Slaggy mineral pitch J. Compact mineral pitch A.

It varies from brownish-black to black; it occurs massive, with a conchoidal fracture, and shining resinous lustre, and is opaque, and very brittle. Specific gravity 1—1.6. When rubbed, it gives out a bituminous odour.

By combustion, it leaves a small quantity of ashes. It consists chiefly of bituminous oil, hydrogen gas, and charcoal, but the latter is in much greater proportion than in elastic bitumen; oxide of iron, and two or three of the earths, sometimes constitute very small proportions of it.

It is found in the Palatinate; in France; at Neufchatel in Switzerland; in large strata in Aolona in Albania; and in large pieces on the shores, or floating on the surface, of the Asphaltic lake in Judea, called the Dead Sea; which is said to have obtained the latter name from the belief that the asphaltum caused the death of birds attempting to fly over it. It abounds in the islands of Barbadoes and Trinidad in the West Indies. In the latter it occurs in a vast lake, three miles in circumference, called the Pitch lake; the thickness of which is unknown. A gentle heat renders it ductile, and when mixed with grease or common pitch, it is used for paying the bottoms of ships, and is supposed to protect them from that pest of the West Indian seas, the teredo or borer. Porcelain jasper occurs near the Lake.

In a vein in Carharack mine in Cornwall, it was found accompanying yellow copper. It occurs also in veins in Haughmond hill in Shropshire. In Scotland in flœtz limestone, and in East Lothian.

The ancients employed bitumen in the construction of their buildings; and it is said that all historians agree that the bricks of which the walls of Babylon were built, were cemented with hot bitumen; which gave them very great solidity. Bitumen was carried down by the water of a river which joined the Euphrates; it was also found in the salt springs in the neighbourhood of Babylon. The Egyptians are also said to have employed it for the embalming of bodies; constituting what now we call mummies.

Bitumen enters into the composition of the black indurated marl or shale which accompanies common coal; and which is generally mixed with it in variable proportion. It is likewise found in certain limestones; for instance, that of Aberthaw, of which bitumen forms about 2 per cent.

BLACK COAL. COMMON COAL.

Schiefferkohle, Blätterkohle, Grobkohle W. Houille H. Slate-Coal, foliated Coal, Coarse Coal J.

It is of a black colour, frequently with an irridescent tarnish.
It occurs massive; the structure in one direction is mostly slaty,
sometimes in two directions; the fragments vary in shape from
LVIII nearly the proportions of the cube, to those of a rhombic prism
(531) greatly resembling that of mica: it sometimes contains thin
parallel layers of mineral carbon; the cross fracture is small
and imperfectly conchoidal, frequently with a brilliant semimetallic lustre. Specific gravity 1.2—1.3. It burns with a
bright flame and much smoke; but this coal commonly contains
CXXIX some proportion of earthy ingredients, and often a very considerable proportion.

(532) Analysis of several varieties of coal by Dr. Thomson. *New-*
CLXXXV *castle*, or *caking coal*, carbon 75.28, hydrogen 4.18, azote 15.96,
(533) oxygen 4.58. *Splint*, or *light-burn hard coal*, from Glasgow,
used for making coke and smelting iron, carbon 75, hydrogen
CLXXXVI 6.25, azote 6.25, oxygen 12.5. *Cherry*, or *soft coal*, from one
of the Glasgow upper beds (of the same kind with the Stafford-
(534) shire), carbon 74.45, hydrogen 12.4, azote 10.22, oxygen 2.93.
Cannel coal, carbon 64.72, hydrogen 21.56, azote 10.72. Dr.
Thomson inclines to the opinion that coal is a direct combina-

tion of these elements, and not a compound of bitumen, &c. as has been supposed.

It occurs in many countries of the European continent, and is the common coal of the most extensive British collieries.

CANNEL COAL.

Kennel Kohle W. Houille H. Candle Coal A.

It is of a greyish black colour, and occurs massive; the fracture is large and flat conchoidal, with a glimmering resinous lustre: it is brittle. Specific gravity 1.2. It burns with a bright flame, but at the same time decrepitates and flies into angular fragments. For analysis by Dr. Thomson, see preceding article. CCCCLX (535

It is commonly found in the upper beds of our coal deposites, as near Wigan in Lancashire, at Clee hill in Shropshire, and near Newcastle in Durham: and in Scotland, at Gilmerton near Edinburgh, and Muirkirk in Clydesdale.

The name Cannel is supposed to be derived from the word candle, because in some places it is used as a substitute. In Scotland it is termed Parrot coal.

As it receives a polish, it is sometimes made into snuff-boxes, ink-stands, &c.

JET.

Pechkohle W. Jayet H. Pitch Coal J.

Jet is generally of a velvet black; it occurs in elongated reniform masses, and sometimes in the shapes of branches, with a regular woody structure. It has a brilliant, resinous lustre, and a perfectly conchoidal fracture; it is soft and brittle, and is but little heavier than water. LI (536

It burns with a greenish flame and a strong bituminous smell, leaving a yellowish ash. It occurs principally in marly, schistose, calcareous, or sandy beds.

It is met with in several places in France: where it is sometimes found enclosing amber. In one place it occurs in oblique beds, at a considerable depth, between beds of sandstone. It is likewise found near Wittemburg in Saxony. It occurs in the Prussian amber mines in detached fragments, and is there called Black amber.

In France and Germany, it is worked into various trinkets chiefly worn as part of the mourning habit; but when not sufficiently fine and hard for that purpose, it is used as fuel.

In England it occurs in aluminous shale, at Whitby in Yorkshire.

BROWN COAL.

Braunkohle W. Lignite W.

XXVIII (537) This substance is perhaps principally characterized by its odour when in a state of combustion, which resembles that of peat; the flame is weak; it appears to have but little analogy with common coal. It occurs massive, and brown of various shades, and brownish black, *(Moor coal)*: the fracture is sometimes earthy, sometimes fibrous, and in the latter instance it generally possesses more or less of the structure of wood *(Wood coal)*; but it is sometimes sufficiently compact to afford a more or less perfect conchoidal fracture with a somewhat resinous lustre, and is nearly black. It yields to the knife, sometimes to the pressure of the nail. 200 grains of the Bovey brown coal yielded by distillation 60 grains of water, acidulous and bituminous; 21 grains of thick brown oily bitumen; 90 of charcoal, and 29 of mixed gases, hydrogen, carbonated hydrogen, and carbonic acid.

It is usually found in alluvial deposits, sometimes in flœtz rocks.

XXIX (538) The earthy and fibrous varieties usually occur together in Mansfeldt in Thuringia, and in the circles of Saal and Leipsic, in beds of 20 to 40 feet thick, and of several square miles in extent; also in the great underground forest in which amber is found in Prussia, and thence termed the Prussian Amber mines. In Iceland; where it is termed *Surturbrand.* It is also found in France, Silesia, Bavaria, and several other European countries, as also is the most compact variety.

In England, the fibrous and compact varieties *(Bovey coal)* are found near Bovey Tracey in Devonshire, forming six beds of various thicknesses, interposed between brownish clay; small veins of coal resembling reeds and grass are found in the clay, together with retinasphalt. The fibrous variety also occurs at the mouth of the Ouse in Sussex.

In Scotland in Fife and Mid Lothian, and in the isles of Sky and Canna.

It occurs abundantly in the Faroe Isles, particularly in Suderoé, and also in the county of Antrim in Ireland imbedded in trap.

DYSODILE. DUSODILE.

Dysodile, Cordier. Houille papyracée Lucas. Merda di Diavolo des Siciliens.

XXVI 164 It occurs in masses of a greenish-grey or of a yellow colour, and either compact or laminated, sometimes both. It is extremely fragile, gives out the argillaceous odour when breathed

on, and is of the specific gravity of 1.146. It burns with a considerable flame and smoke, and an almost insupportably fetid
odour, with a crackling noise, leaving a residue of nearly half CXCII
its weight, unaltered in form. Macerated in water, it becomes
translucent, and its laminæ acquire flexibility. (53

It occurs at Melili near Syracuse in Sicily, in the form of a bed of inconsiderable thickness between beds of a secondary limestone.

AMBER.

Bernstein W. Succin H.

This mineral is yellow of various shades, or of a greenish or
yellowish-white colour; sometimes reddish-brown. It is found CCLXX
in nodules or roundish masses, from the size of coarse sand to
that of a man's head, also in stalactites. It is brittle and yields (54
easily to the knife: it is sometimes transparent, always trans- CCLXX
lucent: the fracture is more or less perfectly conchoidal, with a
vitreous or resinous lustre. It occasionally incloses insects of (54
the ant species, in remarkable preservation. The strong electric powers of amber are generally known. This property gave rise to the science of electricity, which was so called from Ηλεκτρον (Electron) the Greek name for amber.

The real nature and origin of amber are not understood: it is generally considered to be a fossil resin somewhat mineralized. It yields by distillation an acid called the *succinic acid*, (succinum being the Latin for amber) and leaves as the residue an extremely black, shining coal, which is employed as the basis of the finest black varnishes. When exposed to flame in the open air, amber takes fire and burns with a yellowish flame, giving out a dense, pungent, aromatic smoke, and leaving a light, shining, black coal.

It belongs perhaps exclusively to countries of late formation. In Greenland, Kamschatka, and Moravia, it is found in grains disseminated through coal. It also occurs on the shores of the Baltic, of Sicily, and of the Adriatic sea; in Poland, France, Italy, and many other countries; and occasionally in the beds of gravel in the neighbourhood of London, and on the coast of Norfolk and of Suffolk. Near the sea coast in Prussia, there are regular mines of amber: under a stratum of sand and clay about 20 feet thick, succeeds a stratum of trees 40 or 50 feet thick, half decomposed, impregnated with pyrites and bitumen, and of a blackish-brown colour. Parts of these trees are impregnated with amber, which sometimes is found in stalactites depending from them. Under the stratum of trees were found pyrites, sulphate of iron, and coarse sand, in which were rounded masses of amber. The mine is worked to the depth of 100 feet, and from the circumstances in which the amber is found, it seems plain that it originates from vegetable juices. G. B. Sowerby has mentioned to me an interesting specimen which he saw at Baden near Vienna. The wood of a branch of a tree had been converted into jet, of which the centre was amber.

HATCHETINE.*

Rev. J. J. Conybeare.

This singular mineral varies in colour from yellowish-white to wax and greenish-yellow. It occurs either flaky, like spermaceti, or sub-granular, like bees wax. When flaky it has a slightly glistening and pearly lustre, and a considerable degree of translucency; when sub-granular it is dull and opaque. It is of about the hardness of soft tallow, and possesses neither odour nor elasticity; but is so fusible, as to melt in water heated below 170°, and is very light. Like elastic bitumen, it is readily soluble in ether; and each solution, by spontaneous evaporation, leaves a viscid oily matter in separate drops, but that from Hatchetine is still inodorous; while that from elastic bitumen retains strongly the peculiar odour of that substance. Hatchetine distilled over the naked flame of a spirit-lamp assumes the bituminous smell, and gives over a butyraceous substance of a greenish-yellow colour, a coaly matter remaining in the retort; at a lower heat it gives over a light oil.

It is considered by its discoverer, the Rev. J. J. Conybeare, that the characters of this mineral authorize its being considered as distinct from petroleum, asphalt, and elastic bitumen.

It occurs filling small contemporaneous veins, lined with calcareous spar and small quartz crystals, in iron-stone at Merthyr Tydvil in South Wales.

MELLITE.†

Honigstein W. Mellite H.

It is of various shades of honey-yellow, and occurs granular, and crystallized in the form of an obtuse octohedron, of which the common base of the two pyramids is square, and yields to mechanical division parallel to all its planes, but not with brilliant surfaces; the cross fracture is conchoidal, with a glimmering lustre; it is translucent. It is softer than amber. Specific

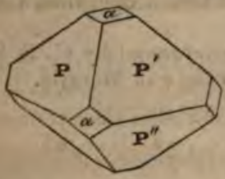
V
165

---

[*] So named in honour of the eminent chemist Chas. Hatchett, Esq. F.R.S.

[†] From the Greek, signifying Honey-stone, in allusion to its yellow colour.

gravity 1.6. It consists of 84 mellitic acid and water, and 16 of alumine, Klaproth. It is slightly resino-electric by friction; before the blow-pipe it becomes of an opaque-white with black spots, and is at length reduced to ashes. When burnt in the open air, neither smoke nor flame is observable, and it eventually acquires the colour and consistence of chalk.



P on P′ 118°8′

P′ on P″ 93.0

The Mellite is a rare mineral, having hitherto only been found in Thuringia, in the district of Saal, and in Switzerland. It occurs on bituminous wood, and earthy coal, and is generally accompanied by sulphur. In Switzerland it is accompanied by asphaltum.

RETINASPHALT.

Retinasphalt, Hatchett.

It occurs in the form of irregular opaque lumps of a pale CLXXX
brownish-yellow colour, with a glistening lustre and imperfect
conchoidal fracture. It is very brittle and soft, and somewhat (54
heavier than water. When placed on a hot iron, it melts,
smokes, and burns with a bright flame, giving out a fragrant CLXXX
odour; 100 parts consist of 55 parts of resin, 42 of asphalt, and (54
3 of earth.

It occurs at Bovey Tracey in Devonshire, adhering to brown coal, and is also found in layers, about $\frac{1}{16}$th of an inch thick, in the coal of the Independent coal-formation in several places in the southern part of Staffordshire. The layers are parallel with those of the coal, which however, is composed chiefly of mineral charcoal.

FOSSIL COPAL.

Fossil Copal, Highgate Resin, A.

Fossil Copal or Highgate Resin was found in considerable
quantity in the bed of blue clay of which Highgate Hill near DXXII
London, in great measure consists. It is in irregular pieces
of a light yellowish and dirty brown colour, somewhat trans- (544
lucent and with a resinous lustre; it is brittle, yields easily to
the knife, and is but little heavier than water, its specific gravity

being only 1.046. It gives out a resinous aromatic odour when heated, and melts into a limpid fluid; when applied to the flame of a candle it takes fire and burns with a clear yellow flame and abundance of smoke, as is the case with other resins; before the blow-pipe it burns away without leaving any perceptible ash. A specimen was deposited more than a century ago in the Woodwardian collection at Cambridge, from a clay-pit near Islington.

It has been found, as I am informed by G. B. Sowerby, in considerable abundance at Wolchow in Moravia.

Substances named in Sowerby
not to be found in Phillips!

CCCCXCIV. 545. Burnt Rock.
DV .546. Turf
CCCXXXV. 547. Alluvial Depositions
CCCXXXVII. 548 . Moulds
CCLXXXI. 549 Water. Ice or Hail.

APPENDIX.

◆

ARFWEDSONITE.

H. J. Brooke.

This mineral has very lately been separated from hornblende, (of which it is commonly assumed to be a ferriferous variety) owing chiefly to the measurements which its cleavages afford: like that mineral it yields to mechanical division only parallel to the lateral planes of a rhombic prism, of which the measurements are 123°.55′, while those of hornblende meet at an angle of 124°.30′. It is of a black colour without a shade of green, has not been observed regularly crystallized, and its cleavage planes are very brilliant, much more so than those of hornblende, which scratches it: Specific gravity 3.44. It has not been analysed.

It sometimes accompanies the sodalite from Greenland.

CLEAVELANDITE.*

Albite ———. Kieselspath, Hausmann. Siliceous felspar, Cleaveland.
Cleavelandite, H. J. Brooke.

This mineral is generally white, or of a greyish white colour, but is also found bluish and blue, and of a dingy red; the white and blue are generally translucent, the red nearly opaque. It occurs massive, and according to Cleaveland, in thin rhombic tables (siliceous felspar) one or more of the lateral edges being sometimes truncated; the massive appears often to consist of a multitude of long and slender crystals irregularly disposed in regard to each other, giving to the surface produced by fracture a somewhat feathery aspect; sometimes however it is regularly laminated, affording distinct cleavages parallel to all the planes of a doubly oblique prism, yielding by the reflective goniometer, in one direction, alternate measurements of 93°.30′. & 86°.30′. in another, of 119°.30′. & 60°.30′. and in the third, of 115°, & 65°. The surfaces produced by cleavage are however more commonly undulating, and are therefore unfit for the goniometer. The specific gravity of the siliceous felspar, ‘probably on account of its interstices,’ is only 2.33; of the albite 2,41. Analysis by Stromeyer of the siliceous felspar, silex 70.7, alumine 19.8, soda 9.0, lime 0.2, oxide of manganese 0,1; of the albite by Eggertz, silex 70.48, alumine 18.45, soda 10.5, lime 0.55. According to Berzelius, the albite of Broddbo and Finbo, and the siliceous felspar of Haddam, present the same results under the blow-pipe as felspar.

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* Cleavelandite in honor of Professor Cleaveland of Bowdoin College U.S. This substance has been considered to be a variety of felspar, from which however it essentially differs in respect of its analysis, and the measurements of its primary form.

The albite, both white and red, is found at Broddbo and Finbo, near Fahlun in Sweden, accompanied by quartz and mica; at Finbo it forms the gangue of the yttrocolumbite. The siliceous felspar occurs at Haddam in Connecticut, and at Chesterfield in Massachusets, where it forms a vein in granite, together with quartz and green and red tourmaline; it is also found at Goshen.

CARBONATE OF MAGNESIA AND IRON.

H. J. Brooke.

This substance has usually been supposed to be a carbonate of lime and magnesia, from which it is not distinguishable by the eye; and like that substance it may readily be cleaved into obtuse rhomboids, which however, when subjected to the reflective goniometer, afford angles different to those of the bitterspar, being 107°.30′ & 72°.30′; it was in consequence of these measurements analysed by H. J. Brooke, Esq. who is induced to conclude that it consists of 1.315 carbonate of iron, and 8,605 carbonate of magnesia, without a trace of lime; he suggests however that a more accurate analysis might possibly vary those proportions.

It is found in the Tyrol in single crystals of a yellow colour, imbedded in talc or chlorite.

CHLOROPAL.

Chloropal, Bernhardi & Brandes.

This newly observed mineral is described as having been divided into two varieties, the conchoidal and the earthy: the conchoidal as being of a pistachio green colour, opaque, or scarcely translucent on the edges, fragile, with a conchoidal fracture, and as being in hardness between fluor and calcareous spar: specific gravity 2. It is described as being apt to break into parallelopipeds, of which that which may be termed the upper plane, when the mineral is in its native place, has a positive magnetic pole, on its lower face a negative. Four other poles occur on its lateral edges, of which two adjoining are positive, and two opposite, negative. It does not phosphoresce. Analysis of the conchoidal variety, silex 46.0, oxide of iron 35.3, magnesia 2.0, alumine 1.0, water 18, and traces of potash and manganese. The other variety has an earthy fracture, possesses the same magnetic properties as the conchoidal; its specific gravity 1,727—1,870: analysis, silex 45, oxide of iron 32.0, manganese 2, alumine 0.75, water 20, with traces of potash and manganese.

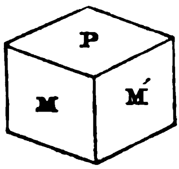
It is found accompanying opal, not far from Unghwar in the Comitate of the same name, and was heretofore termed *Green Iron earth.*

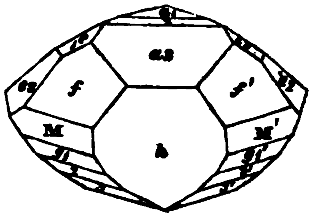
HUMBOLDITE.

Humboldite, Levy.

This newly described and rare mineral occurs in small crystals, which are nearly colourless and transparent, or of a yellowish tinge and translucent, occasionally opaque; they are rarely if ever separate, but commonly are irregularly aggregated; externally they are shining or splendent; their primary form appears to be an oblique rhombic prism, the inclination of the terminal planes being from one obtuse angle of the prism to the other; the lateral planes are alternately, according to M. Levy, 115°.45′ and 64°.15′; the terminal plane P (which has not been observed on any crystal) inclining on the edge formed by the meeting of the lateral planes MM′, or, which is the same, on the plane *h* of the second figure, at an angle of 91°.41′.30″, according to the same authority. The only indication of cleavage hitherto observed, is parallel to the shorter diagonal of the prism. It is sufficiently hard to scratch fluor, but not glass. It has not been analysed, but by the experiments of Dr. Wollaston upon a small quantity, it appears to consist of the same elements as datholite.

Primary.





M on M'	115°.38'	a3 on f or f'	145°.33'
M or M' on a 3	126 .00	e1 on e2	161 .20
M' on e1'	106 .20	e2 on e2'	77 .25
—— e2'	115 .10	e2 on f'	128 .36
—— f'	156 .50	f on f'	121 . 5
M on g1	138 . 5	h on a1	116 .20
—— g2	126 .30	—— a2	126 .15
—— g3	119 .16	—— a3	133 .56
M or M' on h	147 .50	—— e1	89 .25
a3 on e1'	126 .45	—— e2	89 .40
—— e2'	116 .25	—— f or f'	140 .50

The second of the preceding figures, represents a crystal in my possession from a specimen of this substance, liberally presented to me by H. Heuland, Esq.

It has occurred resting on and accompanying calcareous spar, and occasionally with small crystals of Apophyllite, lining the cavities of chalcedonic geodes, in trap rocks, in the Geisalpe, near Sonthofen in the Tyrol: on a specimen in the possession of S. L. Kent, Esq. is a nearly opaque crystal in the form of a right rhombic prism, and having greatly the aspect of Datholite.

LATROBITE.

H. J. Brooke.

This newly described mineral is of a pale pink red colour; and occurs both massive and crystallized, but the crystals hitherto observed are not perfectly defined: it possesses cleavages in three directions, parallel to all the planes of a doubly oblique prism, namely, in one direction alternate measurements of 98° 30' and 81° 30', in another of 91° and 89°, and in the third, of 93° 30' and 86° 30. It scratches glass, and is scratched by felspar. Specific gravity 2.8. It has not been analysed.

It was brought from Amitok Island, near the coast of Labrador, by the Rev. C. I. Latrobe,* and is accompanied by mica, and carbonate of lime, and imbedded in a greyish coloured substance, which is believed not to have been hitherto described.

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* Whence Latrobite.

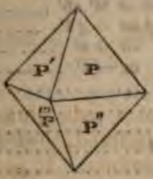
LEUTTRITE.

This substance has been brought from Leuttra (whence Leuttrite) near Jena in Saxony. It appears to be a recomposed rock, perfectly analogous to some of the more sandy varieties of the Domite; it is of a loose texture, gritty and harsh to the touch, leaving on the fingers a white powder. Its colour is greyish white, tinged here and there of an ochreous brown; it includes small fragments of mica, and its cavities are lined by very small and nearly transparent crystals, in the form of acute rhomboids, which appear to have been acted upon externally since their deposition; and as they dissolve with violent effervescence in dilute muriatic acid, and yield to mechanical division parallel to the planes of an obtuse rhomboid of about 105°. by the reflective goniometer, they are considered to be calcareous spar.

BLACK MANGANESE.

Blättricher Schwarz Braunsteinerz, Hausman. Foliated black manganese ore, J. Silicate of Manganese, Berzelius.

It occurs massive, and crystallized in octohedrons, yielding to mechanical division parallel to the common base of the pyramids, which is square. It is of an iron-black colour, opaque, very hard, and affords a brown powder. Analysis of a specimen from Piemont by Berzelius, peroxide and protoxide of manganese 75.80, silex 15.17, alumine 2.80, oxide of iron 4.14. On charcoal in a strong heat it fuses on the edges, and preserves its grey black; with borax fuses readily.



P on P'' or P' on P''' .... 117°30′

P on P' or P'' on P''' 105.45

The above figure represents some crystals from Thuringia in the possession of H. J. Brooke, Esq.

RATHOFFITE.

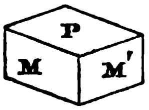
A mineral brought from Sweden under the name of Rathoffite, appears to be a garnet, with which it agrees in crystalline form, affording by the reflective goniometer the measurements of the rhombic dodecahedron having its edges replaced: it possesses cleavages parallel with the planes of that solid, and is externally of a dingy brownish-black colour. It is accompanied by calcareous spar and small crystals of hornblende.

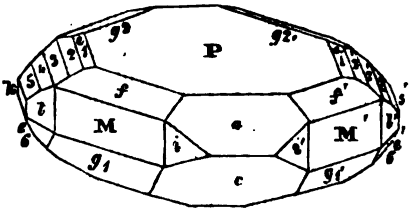
TURNERITE.

Turnerite, Levy.

This rare mineral occurs in small crystals of a yellowish brown or brownish yellow colour, brilliant externally, and translucent, approaching to transparent. The primary form is, as determined by M. Levy, an oblique rhombic prism; but the only natural joints that have been observed (they are occasionally visible by transmitted light) are parallel with both diagonals of the prism; one of them is easily obtained with brilliant surfaces. It scratches fluor pretty readily, but yields to the knife affording a white or greyish white powder. It has heretofore been considered as a variety of Sphene; but, as I am informed by M. Levy, it has been examined by the blow-pipe by Mr. Children, who finds that it contains no titanium, and very little silex; and is of opinion that it contains alumine, lime, magnesia, and a very little iron.

Primary.





M on M'	96°.10'	L	M on e6 or M' e6'	144 .51'	L
P on M or M'	99 .40	L	—— g1 or — g1'	140 .50	L
—— a	142 .29	L	—— i or — i'	162 .15	L
—— e1 or e1'	155 .17	L	—— l or — l'	161 . 2	L
—— e2 or e2'	139 .25		—— k	90 .00	L
—— e3 or e3'	137 .22	L	a on c	92 ·55	
—— e4 or e4'	135 .00		—— f	149 .38	
—— e5 or e5'	117 .48		c on g1	143 .30	
—— f or f'	133 .50		—— k	90 .10	
—— g2 or g2'	153 .52		i on i'	131 .50	
—— k	131 .55		k on g1	126 .30	
M on M' on a	126 .10		—— e6	146 .10	
—————— c	118 .45		—— l	150 .55	

Such of the preceding measurements as have the letter L added to them, were taken by M. Lévy.

It has been found only on Mount Sorel in Dauphiné, accompanying quartz, adularia, lamellary crichtonite, and the octohedrite; and has occasionally been brought into this country under the name of *Pictite*.

ENGLISH INDEX

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